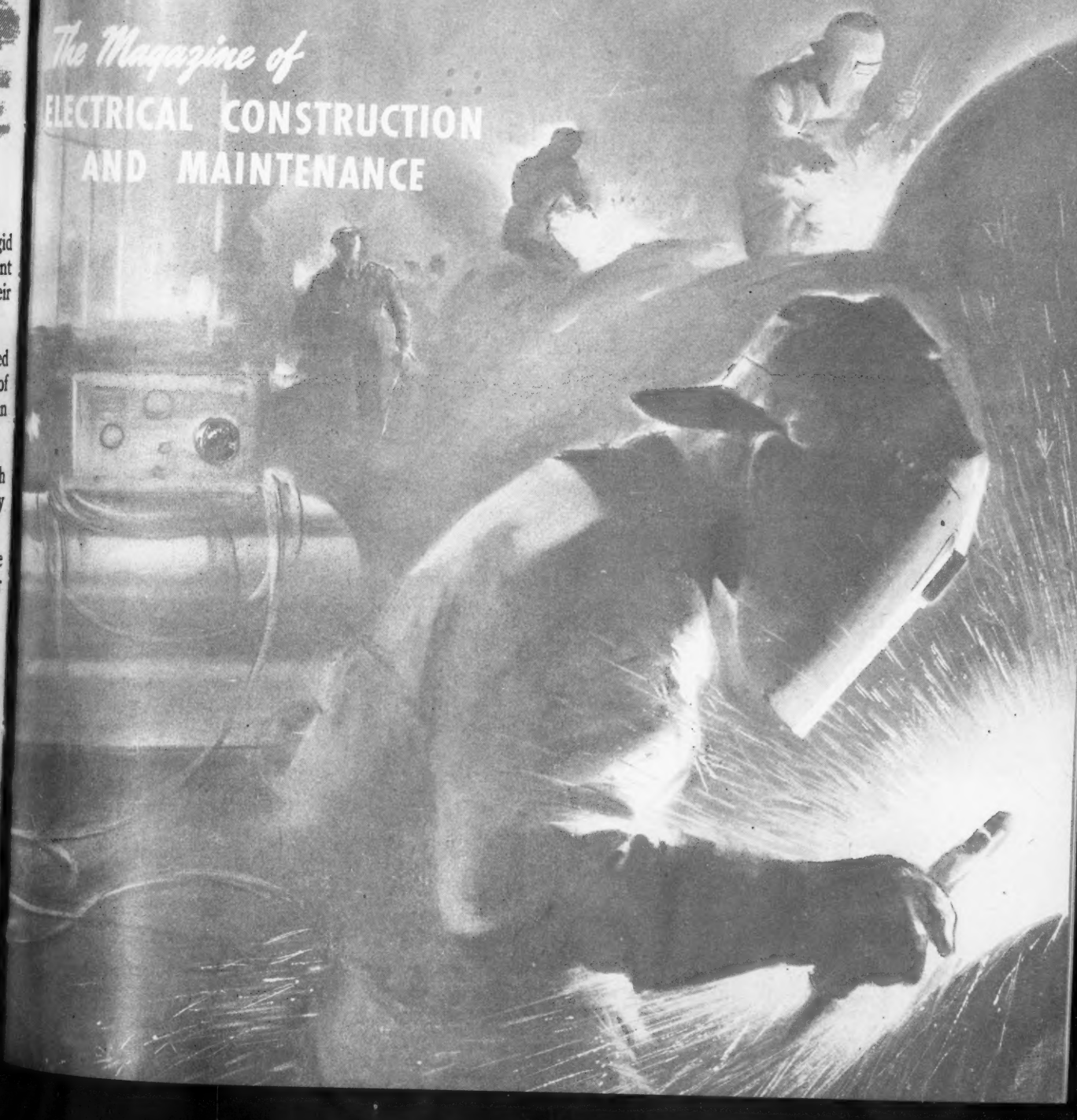
Electrical Contracting

MAR
1944

The Magazine of
ELECTRICAL CONSTRUCTION
AND MAINTENANCE



"IN 6 MONTHS THIS VOLTAGE REGULATOR PAID FOR ITSELF TWICE OVER IN SAVINGS IN PAPER AND MAN-HOURS"

. . . reports blueprint-machine user

3.6-kva, automatic, induction voltage regulator (Control panel is mounted separately.)

PROBLEM A large Midwestern plant was experiencing considerable trouble in its blueprinting department because of fluctuating voltage. This poor voltage condition was caused by a varying power and lighting load. The high-intensity, mercury-vapor lamps being used in blueprinting were burning out needlessly. Large quantities of blueprint paper were being wasted because it was necessary to make trial prints at various times of the day to determine proper exposure. There was also a waste when making microfilm records of large-size prints, because varying voltage caused a varying intensity of light and, hence, underexposure or overexposure.

SOLUTION No *special* equipment was needed to lick the problem. General Electric engineers suggested two 3.6-kva, 240-volt, automatic, dry-type, induction voltage regulators, selected from our standard AIRS line.

RESULTS Now, after less than six months, the manufacturer reports that these *automatic* regulators have already paid for themselves at least twice—in materials plus man-hours saved. Under the old setup, it was necessary to adjust the voltage by hand several times a day.

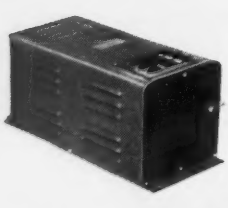
WHAT'S YOUR PROBLEM? Pepless motors, poor lighting, uncertain test results, and production slumps are often the result of poor voltage. Whether you need voltage control for a vacuum tube or a power shovel, there's a simple, economical G-E device for the job. *General Electric Company, Schenectady 5, N. Y.*

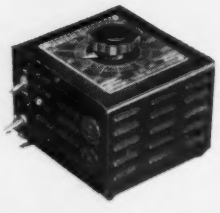
OTHER G-E AIDS TO BETTER VOLTAGE

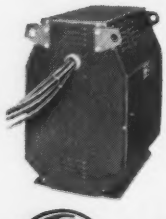
VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.

VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.

TYPE D TRANSFORMER—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage for the most economical operation of motors, welding equipment, etc. Ratings up to 100 kva, 600 volts.







THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**

BUY WAR BONDS

GENERAL ELECTRIC

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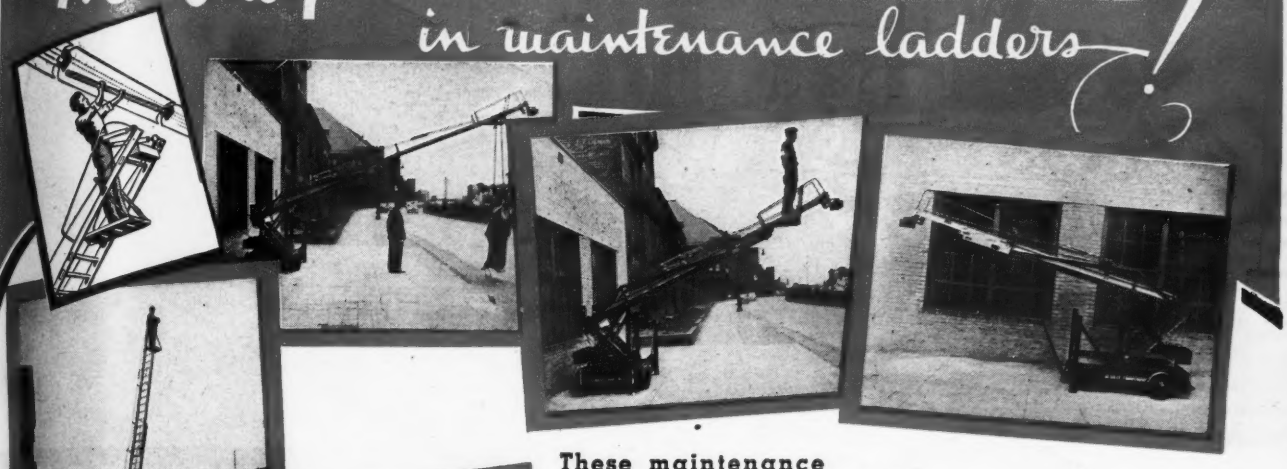
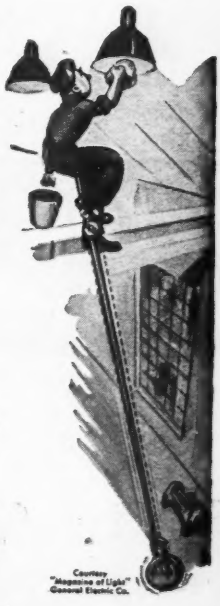
"Murray"—the modern STANDARD in maintenance ladders!



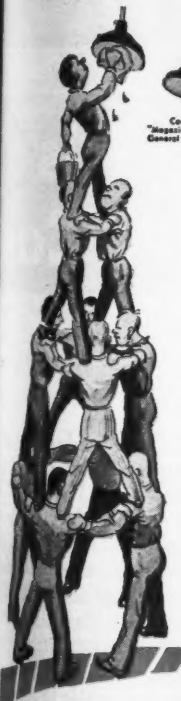
These maintenance units make overhead servicing *so* fast and easy that light output is kept at maximum.

The chief advantage of these Murray Crows'nests is that they make overhead, out-of-the-way lights, unit heaters and sprinkler heads, easily accessible, without disturbing men, machines or production schedules in the slightest.

All the many important plants which have taken on Murray Crows'nests, wonder how any plant ever got along without them. Fill in the coupon and mail—we'll propose a unit suiting your particular needs. Metropolitan Device Corporation, Brooklyn 16, N. Y.



Courtesy "Magazine of Light" General Electric Co.



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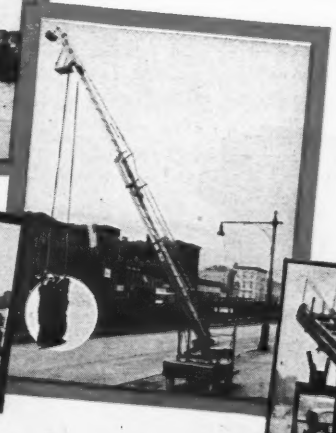

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Brooklyn 16, N. Y.

Send data (without obligation) on Murray Crows'nest suitable for our requirements.
Ladder must reach feet high, and extend feet side-ways. Aisle width is feet.

Name and Title_____

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Murray Crows'nest

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TOUGH—like a TANK

BATTER IT

TWIST IT

BEND IT

You Won't Break It Because It's An APPLETON "UNILET"—and It's Cast

MALLEABLE IRON

AN APPLETON CAST MALLEABLE "UNILET"
For Every Requirement

Tough . . . and then some! Appleton "Unilets" are made of the same stuff used for tank steering, braking, drive and clutch assemblies, engine supports; gun mounts, and controls—*Cast Malleable Iron*. They're tough enough to take any punishment . . . and ask for more.

Appleton "Unilets" are stronger, yet lighter, than ordinary cast electrical fittings. Their perfect alignment, the precision with which they're made and finished, expedite installation and improve workmanship all around. They last as long as any building.

In the complete Appleton line are more than 15,000 distinct types and sizes of "Unilets", Outlet and Switch Boxes and Lighting Fixtures—*exactly the right fitting for every purpose*—all made in Appleton foundries and fabricating plants under highest quality standards. They're "STANDARD FOR BETTER WIRING!"

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Electrical Contracting

With which is consolidated The Electrogist and Electrical Record . . . Established 1901

OUR COVER this month is "Welding in Industry," the seventh in a series of original sketches of electrical equipment in wartime by Artist Stephen Grout.

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

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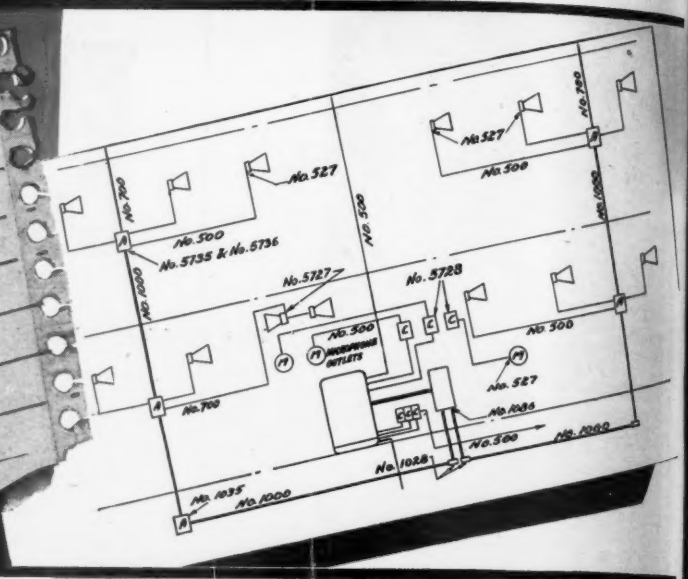
the problem

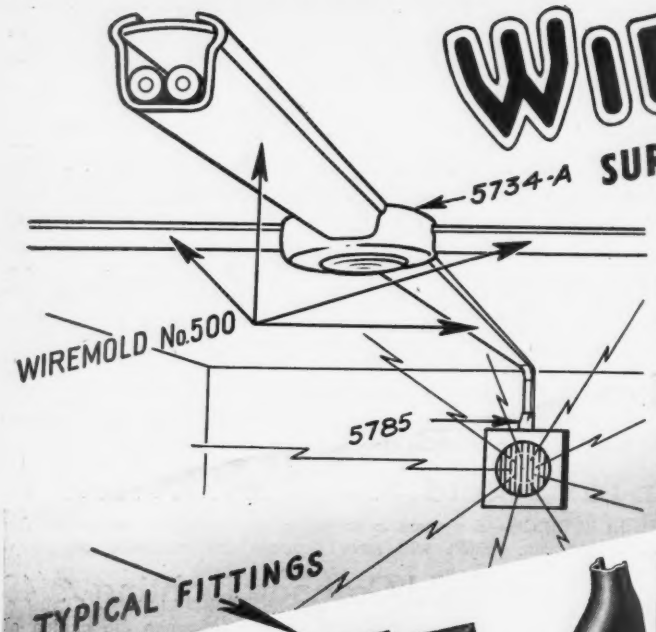
Signal system wiring in schools hospitals, hotels and war plants



the answer

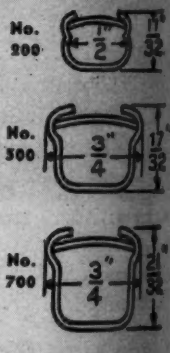
WIREMOLD

SURFACE METAL RACEWAYS



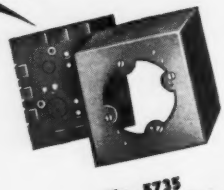
● Wiremold makes it easier to plan and install special wiring for fire alarm, radio, process control, plant telephone and call signal systems.

On-the-surface installation is more accessible . . . can be extended or relocated easily. Strong steel Wiremold raceways are safe, permanent, easy to wire or rewire . . . better for the customer, better business for the contractor.



TYPICAL FITTINGS

No. 5728
Utility Box



No. 5735
Distribution Box

No. 1086
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No. 5727
Plug Receptacle
15A, 125V; 10A, 250V

WIREMOLD RACEWAYS AND FITTINGS CONFORM TO IMSA SPECIFICATION NO. 105; FEDERAL SPECIFICATION W-R-32. LISTED BY UNDERWRITERS' LABORATORIES, INC.

Catalog and wiring guide . . . bulletins . . . engineering data sheets . . . free on request to the Wiremold Company.

WIREMOLD CAN HELP YOU PRODUCE FOR WAR . . . WHILE YOU PLAN FOR PEACE!

KNOW YOUR

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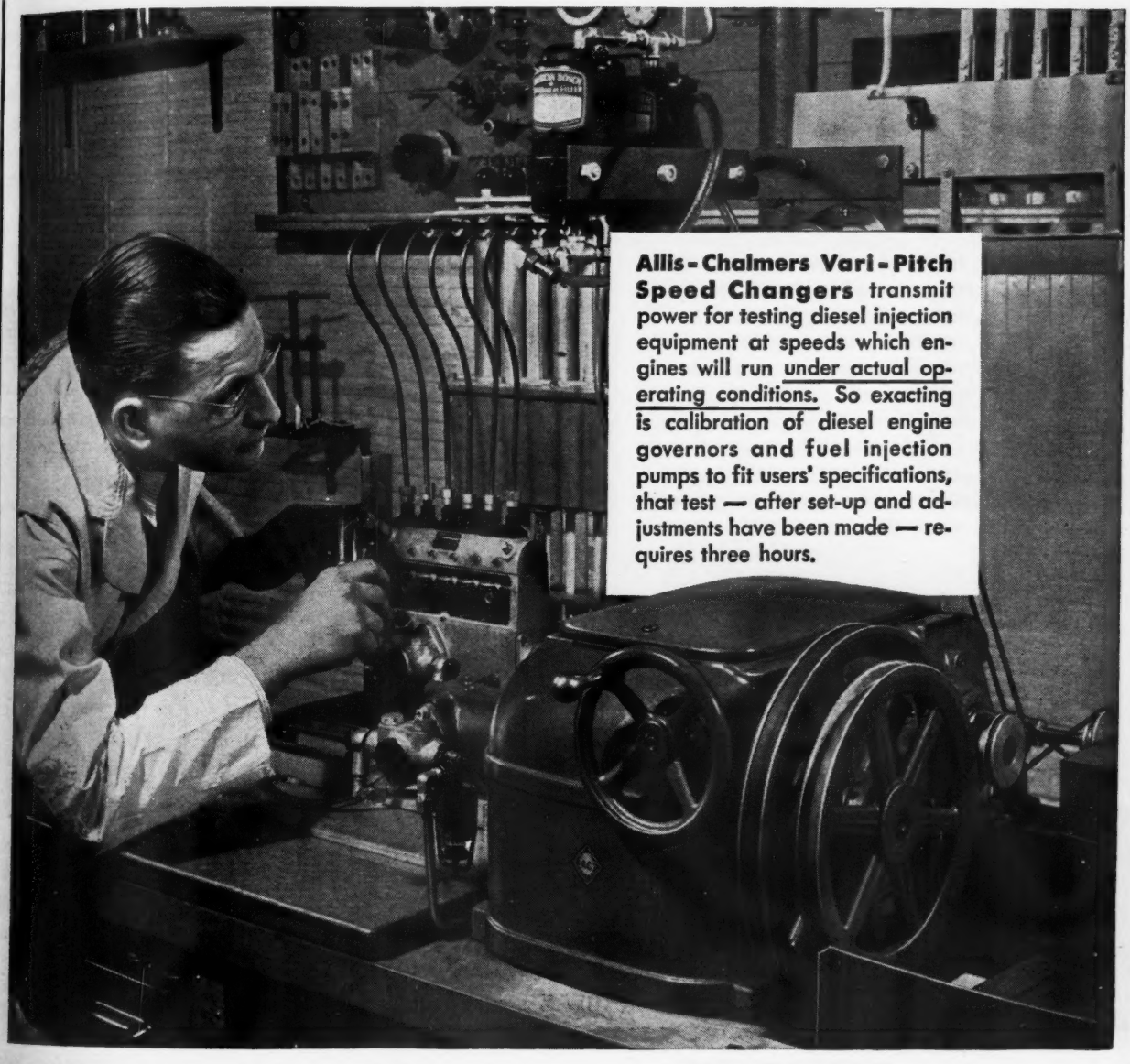
THE WIREMOLD COMPANY HARTFORD 10, CONN.

PRODUCT OF THE MONTH



Allis-Chalmers Vari-Pitch Speed Changers transmit power for testing diesel injection equipment at speeds which engines will run under actual operating conditions. So exacting is calibration of diesel engine governors and fuel injection pumps to fit users' specifications, that test — after set-up and adjustments have been made — requires three hours.

MILWAUKEE, WIS. — Allis-Chalmers Vari-Pitch Speed Changers supply unwavering power to precision machines calibrating diesel engine governors and fuel injection pumps . . . where clearances of 39/1,000,000 of an inch can be measured only by oil leak-off, not by micrometer. Send for B6013.

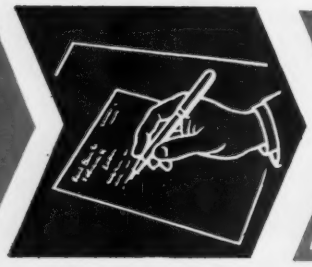
A 1704

WE WORK FOR VICTORY — WE PLAN FOR PEACE

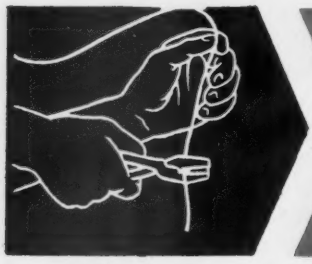
ALLIS-CHALMERS · MILWAUKEE · WISCONSIN

You Save[1] and Save[2] and Save[3]

1 SAVE ORDERING TIME



Instead of buying two separately mounted devices—a motor-circuit switch and a magnetic starter—you buy one factory-co-ordinated unit that controls and protects your motor. Simply specify the motor rating and indicate the type of motor-circuit switch you want—and we'll send you the control you need.

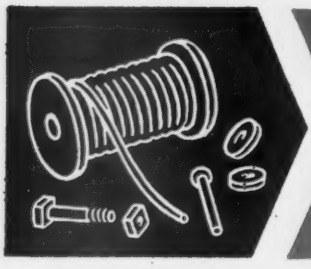


2 SAVE INSTALLATION TIME

Users report a 50 per-cent reduction in mounting time, 40 per-cent reduction in wiring time, as compared with the installation of two separate devices. You mount one device—not two. You connect only nine terminals—not fifteen. You get your motors into operation quicker.

3 SAVE MAN POWER

By eliminating one complete mounting job on every installation, you save valuable man power. And because the cover cannot be opened while there is power on the starter, your men have more protection against accidental injury.

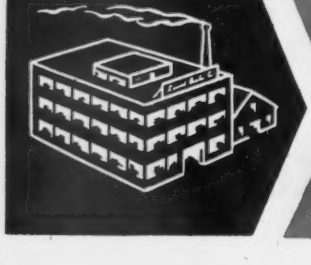


4 SAVE CRITICAL MATERIALS

By buying both the motor-circuit switch and the magnetic starter as one compact unit, you save copper wire, steel conduit, and fittings that are necessary for installing two separately mounted devices—plus the saving gained by using only one steel enclosure instead of two.

5 SAVE MONEY

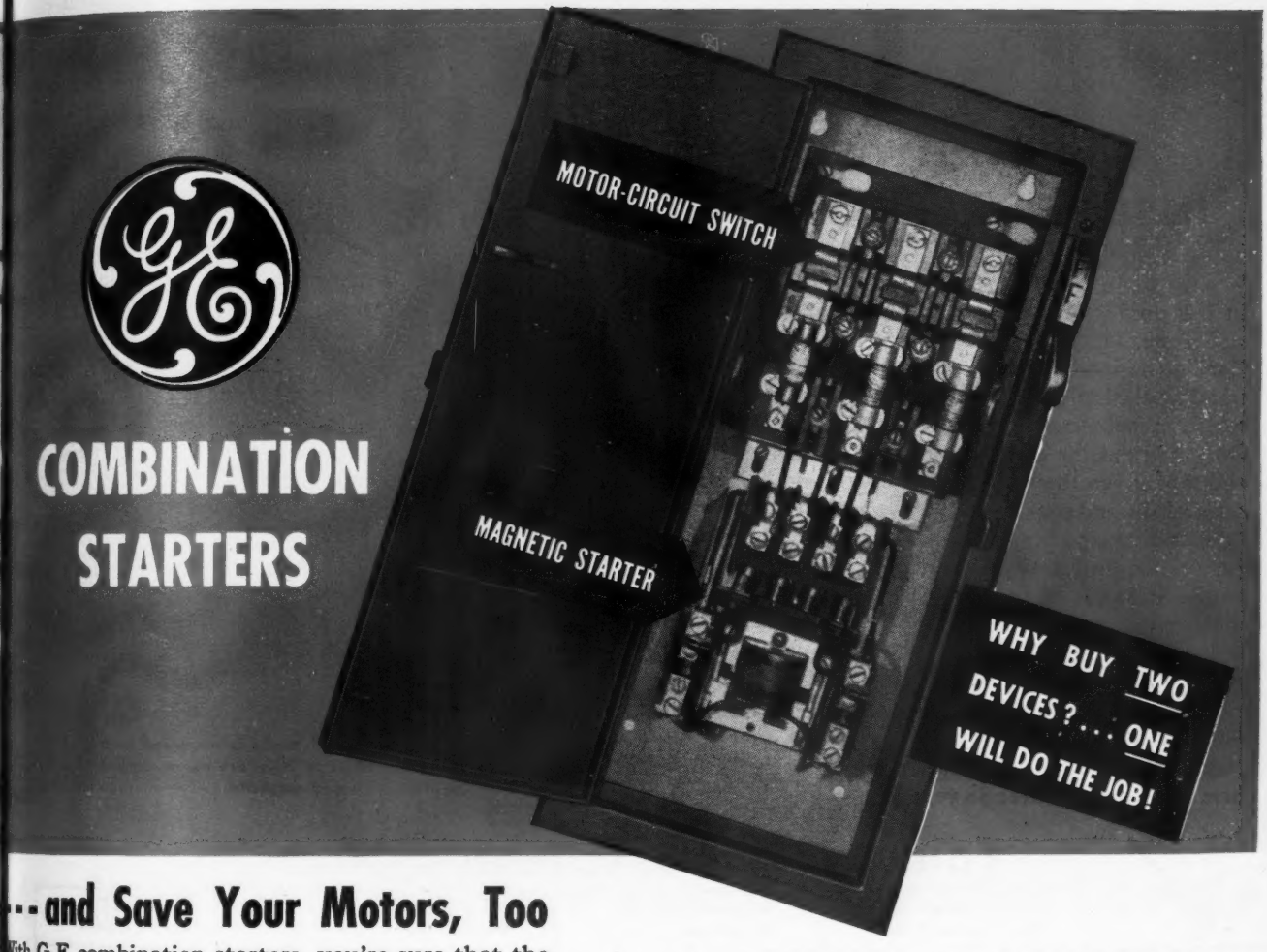
Combination starters cost slightly more than two separately mounted devices, but this difference is more than made up by the savings in wire, conduit, fittings, and installation-labor costs. This statement is based on the actual experience of users.



6 SAVE PLANT SPACE

Combination starters take up less mounting space than separately mounted safety switches and starters. Because of this you can mount them in small, unused places near the operators.

and Save[4] and Save[5] and Save[6]...



...and Save Your Motors, Too

With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating and interrupting capacity for the magnetic starter with which it is used. The fuses or breaker are coordinated with the thermal overload relays to give complete motor protection under short-circuit or overload conditions.

It's the simple, logical way to get control and protection for your motors—in one compact, easy-to-install unit. Why buy two devices, when this one will do the job?

NAME YOUR HAZARD

G-E combinations come in enclosures to meet any operating condition: dust-tight, watertight, oil-immersed, general-purpose, or for hazardous locations. Available for motors from 1 to 1000 horsepower.

GENERAL ELECTRIC

Next time you order motor control, save seven ways by specifying General Electric combination starters.
General Electric Company, Schenectady, N. Y.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

General Electric Company, Section M676–129
Schenectady, N. Y.

Please send me the bulletins checked below:

- GEA-3715—Combination starters: general-purpose, watertight, and dust-tight
- GEA-3660–2300-volt combination starters
- GEA-3804—Combination starters for hazardous locations
- GEA-3541—Oil-immersed starters

Name.....

Company.....

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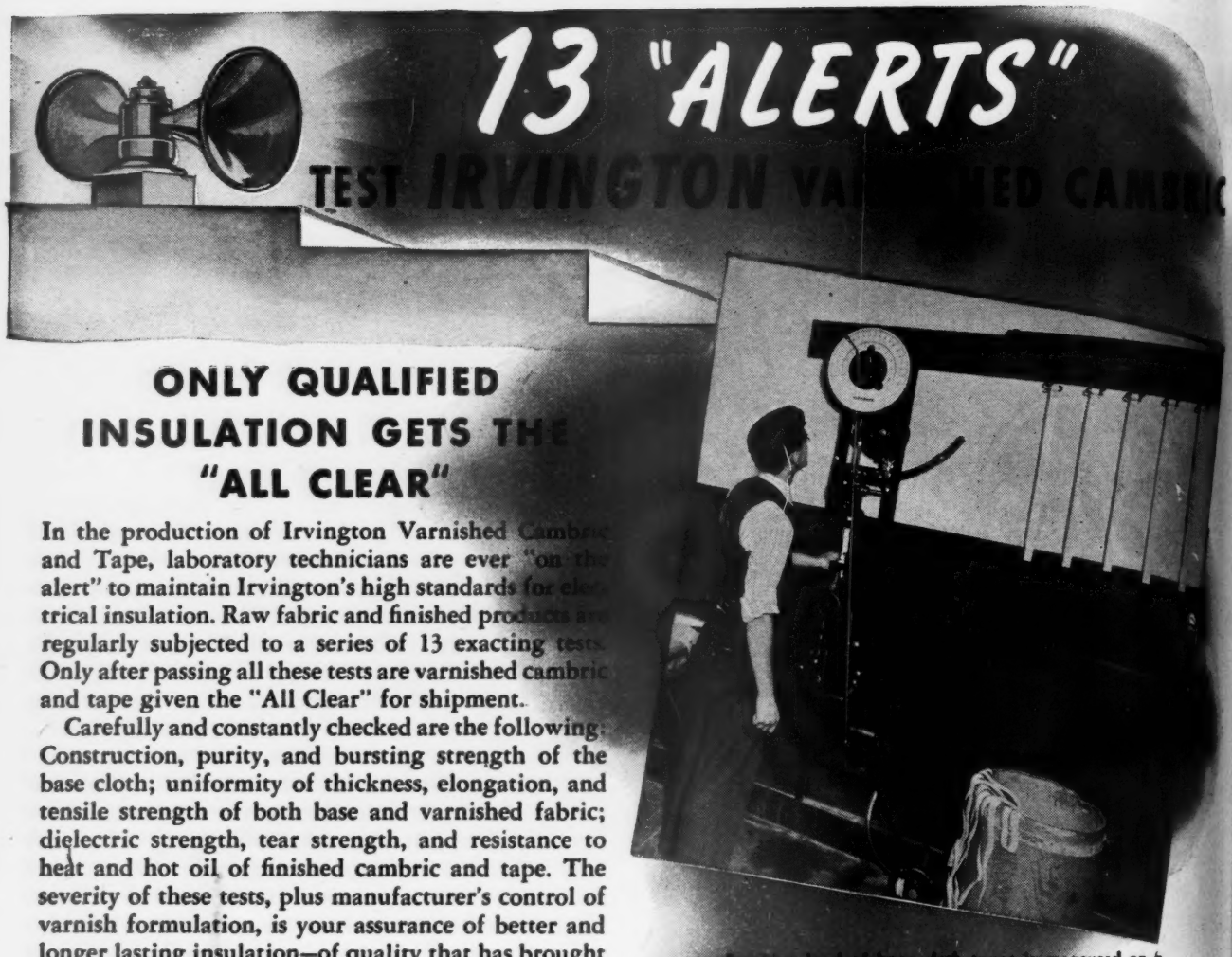
City.....State.....

5920



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In the production of Irvington Varnished Cambric and Tape, laboratory technicians are ever "on the alert" to maintain Irvington's high standards for electrical insulation. Raw fabric and finished products are regularly subjected to a series of 13 exacting tests. Only after passing all these tests are varnished cambric and tape given the "All Clear" for shipment.

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Breaking load of base cloth tapes is measured on a Scott Tensile Tester. Strips at right are being checked for average elongation and elasticity.

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Applications	For hand or machine taping of straight, even surfaces		For hand or machine taping of irregular surfaces and contours	
General Properties	Resistant to abrasion, aging, heat, water, acid and alkalies; smooth and flexible.			
Special Properties	Resistant to lubricating oil	Resistant to insulating oil	Resistant to lubricating oil Elongation — — 1.7% @ 20 deg. C. (.010" Th.)	Resistant to insulating oil Elongation — — 1.5% @ 20 deg C. (.010" Th.)
Dielectric Strength (.010" thickness) volts per mil	1050	950	As received — 1000 After elongation — 800	As received — 900 After elongation — 575
Tensile Strength (.010" thickness) — lbs. per 1" width	40	38	38	35
Indicated Uses	On corners and between layers of field coils; for phase insulation of stators; as slot insulation; and for overall coil wrappings	For wrapping small coils and coil forms; as insulation between windings of ignition, magneto and transformer coils, as slot, end winding and phase insulation.	Where tight, smooth lap winding is required as on armature and field coils; for bus bar and terminal insulation; for taping cable joints and connections.	Especially suitable for transformer and other coils which operate in insulating oil; armature, field and other coils involving angles and bends.

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IRVINGTON *Electrical* INSULATION

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Today there's *less* wire — but *more* variety!

With synthetics now necessarily being used in place of rubber, you're probably confronted with a multitude of unfamiliar wires and cables. Yet Hazard engineers quickly can steer you through this maze to the selection of the proper cable for any installation. And the cables they recommend won't be untested substitutes, hastily developed to meet the wartime emergency.

Our study of synthetic insulating and sheathing materials was started *13 years before this war began.* Many of these were developed to supply specific properties (such as resistance to heat, flame, oil, chemicals, etc.) which could not be obtained with conventional materials. Now, through continuing research, these *tested* and *proved* products — further developed and augmented by others — are ready to help keep vital electrical systems functioning at their usual efficiency.

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3508

HAZARD
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For SAFETY'S sake . . . use CONDUIT
(Full Weight Rigid Steel)

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You can count on using standard-threaded, full-weight rigid steel electrical conduit wherever real protection is needed -- for strength and endurance, for prevention of penetration of moisture, vapors and dust, for effective resistance to shock, vibration, corrosion, arcing and short circuiting.

After the demands of war are satisfied, you'll be able to get all the rigid steel conduit you want. Your distributor will have Youngstown BUCKEYE CONDUIT in stock again -- in all the sizes and quantities you'll need.

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN 1, OHIO
Manufacturers of
CARBON, ALLOY AND YOLOY STEELS

Right - This upper floor remained unfinished for several years. The rigid steel conduit afforded vital protection to wiring, against careless workmen and intruders.

Ask your distributor for:
Youngstown Buckeye Conduit . . . Pipe and Tubular Products . . . Sheets . . . Plates . . . Tin Plate . . . Bars . . . Rods . . . Wire . . . Nails . . . Tie Plates and Spikes

FLAMENOL

Simple test demonstrates value of G-E synthetic cable

Before you install wiring in a location where there is danger of fire, *first* make this test:

Light a match, and hold a piece of Flamenol* wire in the flame. Use several matches, one after another. The insulation will char, but it will *not* burst into flame. Therefore, Flamenol gives you this assurance: If fire *does* break out, *it will not be spread by the wiring.*

Flamenol Has Proved Itself

The insulation on Flamenol wire and cable is *not* a newly developed and temporary substitute. Designed to overcome the disadvantages inherent in other insulations, it has been in commercial use more than *eight years.* Its many advantages, listed at right, have been proved under severe conditions of service in thousands of industrial installations.

As a result of thorough tests carried out over long periods of time, many of the country's leading chemical, oil, automotive, and other companies changed to Flamenol long before the rubber shortage. For further information, constructions, suggested uses, etc., write to the nearest G-E office. *General Electric Company, Schenectady, N. Y.*

12 BIG ADVANTAGES offered by FLAMENOL

1. FLAME RESISTANCE—does not support combustion.
2. CORROSION RESISTANCE—immune to action of oils, acids, alkalies.
3. SUPER-AGING — does not oxidize. Highly resistant to sunlight and weathering.
4. EXCELLENT PHYSICAL PROPERTIES—has minimum tensile strength of 1500 lb per sq in., minimum elongation of 100 per cent.
5. DIELECTRIC STRENGTH — retained at about 720 volts per mil through severe operating conditions.
6. SMALL DIAMETER — saves space, facilitates wiring.
7. SMOOTH SURFACE—facilitates pulling through conduit.
8. FREE STRIPPING—speeds splicing, avoids nicking conductors.
9. DIFFERENT COLORS—simplify circuit tracing.
10. VARIOUS CONSTRUCTIONS—aid selection for special applications.
11. SELF-PROTECTING FINISH — eliminates need for braid, less space required.
12. ATTRACTIVE APPEARANCE—is maintained through long service, painting is never needed.

BUY WAR BONDS

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

502-46-1200

When it's Important-

THEY USE R&S FITTINGS AND FIXTURES

Here's why:

1. The electrical engineer designing an industrial plant, oil refinery, or ship will tell you that he can make the electrical installation moistureproof, watertight, dust-tight, and explosion-proof by specifying fittings and fixtures from a single catalog, R&S No. 90.

2. He can mention a dozen recent war-time jobs that are R&S throughout and that are overcoming all these hazards. He knows of many R&S peace-time jobs in his vicinity that have operated satisfactorily for a quarter century or more.

3. He knows that nearby contractors and jobbers are familiar with R&S products, are in a position to render information and service and that they also will compliment him on specifying R&S.

For security of operation for a lifetime in hazardous locations, what more confidence would he need?

We are looking forward to the day when R&S can again serve you in your peace-time enterprises. Let's talk it over now.

RUSSELL & STOLL
EXPLOSION-PROOF
WATER-TIGHT
DUST-TIGHT
or
WEATHER-TIGHT
FIXTURES
and
FITTINGS

RUSSELL & STOLL COMPANY
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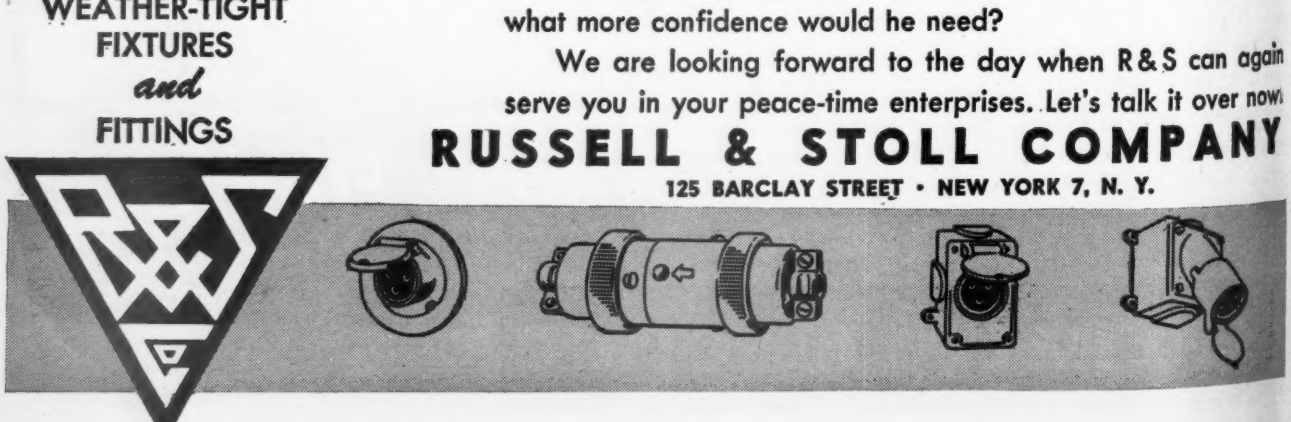

REDESIGNED FOR UNIFIED APPEARANCE OF BALLAST AND NEW FLUORESCENT FIXTURES

STREAMLINED
to better fit the contours of your fixture
PAINTED GRAY
to match the finish of most fixtures
LEADS OUT THE BOTTOM
for easy installation on narrow wiring channels

HERE'S a ballast that is *made for* external mounting. Its streamline, drawn-steel case, dark-gray finish, and "bottom leads" give the ballast and fixture a *unified* appearance.

Electrically, this ballast is exactly the same as our standard design—the same high quality and dependability. As it can be mounted completely exposed, it operates in lower ambient temperatures—which contributes to long ballast life. Special installation features such as ventilating louvers and conduction plates are not required.

This ballast is available in Tulamp 40-watt ratings, for circuits of 118, 208, 236, and 260 volts.

FOR MORE INFORMATION about this improved design, and for details on our complete line of single-lamp, Tulamp, three-lamp, and Forlamp ballasts, send for our newly revised catalog, GEA-3293. *General Electric Company, Schenectady, N. Y.*

BALLASTS FOR FLUORESCENT LIGHTING

Certified by ETL
Listed as approved by Underwriters' Laboratories, Inc.

★

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

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JEFFERSON'S OWN MEN

JEFFERSON ELECTRIC

Located accessible to every part of the country, the Jefferson corps of experienced sales engineers is immediately available at all times.

These men are thoroughly acquainted with all the products carrying the Jefferson name. They are ready to assist in making proper selections,—make recommendations, and help you increase your sales and profits.

The long established acceptance for Jefferson Electric Transformers, Ballasts, Jefferson Union Fuses—is the result of reliable performance from one end of the country to the other for more than a quarter of a century to meet your particular requirements.

JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago) Illinois

Canadian Factory: 60-64 Osler Ave., W. Toronto, Ont.

Available IN COMBINATION UNITS, TOO...

The Monitor THERMALOAD V

SOLENOID STARTER

WITH *Compensated* OVERLOAD RELAY

Get all the facts about the Monitor Thermaload V Solenoid Starter. Learn how the unique Monitor COMPENSATED overload relay prevents unjustified shutdowns under high temperature conditions and assures maximum overload protection under low temperature conditions. Learn about the Monitor tamper-proof reset button . . . why Monitor contacts are of pure fine silver . . . why the Thermaload V reduces motor maintenance costs, adds life to motors. These and many other important details and facts are discussed thoroughly in Bulletin 6300.

Ask the Monitor field engineer in your territory for a copy or write direct.

Ask Yourself these Questions

ARE MY MOTORS
up to 3 H.P., 110 Volts, A.C.?
up to 7.5 H.P., 550 Volts, A.C.?

ARE THEY
single-phase? two-phase? three-phase?

DO I REQUIRE
general purpose enclosure (N.E.M.A. Type I)?
dust-tight enclosure (N.E.M.A. Type V)?
water-tight enclosure (N.E.M.A. Type IV)?

IS WIRING TO BE
front-of-board? back-of-board?

AM I INTERESTED IN MAXIMUM OVERLOAD PROTECTION FOR MY MOTORS?

If the answers are YES . . . then you can take advantage of the many benefits that Monitor Thermaload V Starters offer.

The Monitor Controller Company

GAY, LOMBARD & FREDERICK STS. BALTIMORE-2, MARYLAND

Monitor — The Original — JUST PRESS A BUTTON

A FLOOR THAT'S MORE THAN A FLOOR

It's a Q-Floor. It consists of a series of cellular steel wiring raceways which are easily accessible through a system of headers. It provides 100% electrical availability.

See how quickly you can drill into Q-Floor raceways in any 6-inch square over the entire floor area, fish in your wiring and quickly install floor outlets.

Q-Floors are adaptable to all types of wiring covered in the National Electrical Code. Rearrangements and changes of office equipment or plant layout can be quickly and economically made at any time.

Before you plan postwar construction, get in touch with your nearest General Electric Merchandise Distributor. He'll be glad to send Q-Floor literature.

Q-Floors and Fittings Manufactured by

H. H. ROBERTSON CO.
Farmers Bank Bldg., Pittsburgh, Pa.

ROBERTSON Q-FLOORS

Disposal of Government Inventories

How to dispose of government surpluses when the war ends need not be an insuperable problem – if we face it promptly and intelligently. But if we do not, peacetime markets may be disrupted, government funds wasted, production discouraged, and reconversion of the whole economy to peace seriously hampered.

What we need most in order to attack the problem is estimates of how much surplus there will be, in what types of goods, and where.

At the war's end, government inventory of war goods is likely to total around 60 billion dollars. Most of this will consist of aircraft, ships, and other ordnance. Only some 15 billion dollars or less will be in food, clothing, trucks, tools, chemicals, medical supplies, transportation, engineering and communication equipment, and other goods for which there is a civilian market.

In addition, war contractors will have about 10 billion dollars of inventories, the bulk in specialized raw materials, goods in process, and finished products. Only about one-fifth of the total, or some 2 billion dollars, will be marketable or usable for civilian purposes. While the government takes over the usable inventory, the ex-war-contractors will have to build up their stocks for peacetime production, so that on balance, they will not be disposing of usable inventories in large volume.

Not even all of the usable war-end inventory will be "surplus" for sale to civilians in competition with new production. Some of it will be needed by the sizable peacetime Army and Navy we are likely to maintain, and such additional items as can be stored without serious deterioration or obsolescence will be held against possible future war emergencies. Some of it will be disposed of abroad. And up to half of it will be abroad and may be sold there or used for relief.

After allowing for these factors, the war supplies to be disposed of in our own markets probably will be less than 10 billion dollars (cost basis). While the total is not overwhelming – the equivalent of two months' retail sales – in certain lines the surplus will be several years', instead of a few months', normal supply. In particular, the volume of scrap metals available from otherwise unusable munitions will present a problem.

A great deal can be done now to reduce the size of the postwar surpluses by achieving a better balance between military needs and supplies and avoiding excessive inventories of particular raw materials or finished goods. This work needs to be pressed, not only to simplify our transition to peace but also to prevent wasting productive energies during the war. Furthermore, when the war ends on one front, inventories of war materiel should be worked down to the reduced scale of remaining military activity.

We cannot develop programs of action until we know approximately how much of each type of item is to be sold, and where and when it will be available. Wide margins of error are inevitable as long as large-scale procurement and large-scale consumption are still taking place; yet such information is essential and must be developed. Indeed, improved inventory records and estimates are badly needed for the conduct of the war as well as for managing the surpluses after hostilities cease.

In decisions on the disposal of war-goods inventories, the public interest must be the prime consideration. Proposals that none of these goods should be sold domestically because of competition with new production obviously are untenable. Everything that is not needed by the Armed Services or for other special purposes should be disposed of ultimately. The real problem is not whether surpluses should be sold, but rather to whom, at what price, and at what time the sale should be effected.

In the distribution of such large quantities of goods, we believe that established trade channels should be used wherever possible. Otherwise, we shall witness widespread speculation in war goods and the mushroom growth of inefficient and disruptive fly-by-night distributors. This will benefit only a few speculators and will discourage legitimate producers and distributors from making their normal commitments.

All war contractors should have the privilege of retaining those inventories for which they are willing to pay actual cost or a fair price negotiated with the gov-

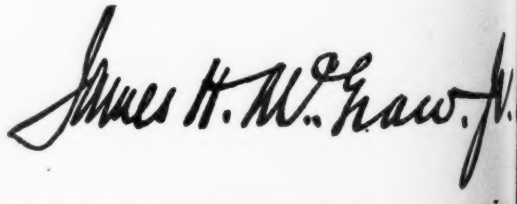
ernment procurement agency. The balance of the inventories in the hands of war producers should be assembled by the government and sold in an organized manner. It is of great importance that the plants be cleared of these inventories at once so that the process of conversion to peacetime operation can proceed without further delay. To accomplish this, preparations must be made before the end of the war for speedy determination of the inventories to be moved and for a huge volume of storage space to accommodate them.

The price which can be realized and the timing of sale are closely related. Certainly the best prices will not be secured if the government attempts to dispose of large supplies of material and products suddenly without regard to market conditions. Most businessmen rightly favor an early transfer of surplus inventories from government to private ownership. But, they also realize that if all the surpluses are dumped indiscriminately as they become available, many markets will be badly depressed, and the resulting low prices will bring lower production. If this depression effect becomes general, as it easily can, it will be costly to the nation in terms of jobs, income, and goods.

In industries in which production is inadequate to meet postwar demands, an immediate sale of government inventories can prevent inflated prices and preserve balanced market conditions. In cases in which the surpluses are large in relation to annual production, the disposition can be scheduled over a period of years. Generally, however, it will be best to clear the surpluses as quickly as orderly sale can be accomplished rather than to leave them as a continuing threat overhanging the market. Most industries can, and should, take the disposal process in their stride without special dispensations from the government. In this connection, it should be noted that the tax provisions for carry-back of losses and excess profit credits after the war greatly increase the possibilities for speedy disposal of surpluses without serious injury to producers.

There will be some industries, however, in which the postwar surplus is so large that it would practically saturate the market for years to come. The problem of these industries is further complicated by their wartime expansion of capacity many fold in excess of peacetime requirements. These lines of production are, moreover, crucial for our national defense. Aircraft and shipbuilding are cases in point. Each of these situations calls for careful study and discussion by all concerned to devise means to keep alive the necessary production organizations, the research effort, and the spirit of enterprise. Insofar as possible, the individual manufacturers should work out their own salvation in the conversion to peacetime markets. They can do this by taking on new lines, by increasing their production efficiency, and by developing technical improvements which make the existing inventories obsolete. But they still will need some kind of government protection or assistance while the huge surpluses are being worked off. It is most important, however, that such protection or subsidy be limited to a period of three to five years. It must not become permanent unless it is really essential for our national security.

The disposal of surplus inventories is part of the whole process of demobilization of the war effort and conversion to peace. If this process is to be accomplished with minimum dislocation and injury to our economy, it will have to be directed by a central agency which has developed adequate information service and is in position to coordinate the policies of the Armed Services and the other interested executive branches of the government. This agency should draw freely on the knowledge of businessmen in the specialized problems of marketing surpluses in each industry. It should formulate definite programs of inventory disposal for all industries in which the problem is acute; and it should make these programs public as soon as possible, so that business can plan for the future with confidence. In large measure, the success with which we make the economic transition to peace will depend on the quality of government administration in the process of industrial demobilization. We shall need better organization for the transition to peace than we had in mobilization for war if we are to avoid needless unemployment, loss of production, and frustration of business enterprise.



President, McGraw-Hill Publishing Company, Inc.

It's Easy

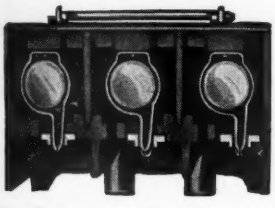
to slip in the fuses— but they're *clamped tight* for perfect contact . . .

Fuse clamp switch blades open slightly when fuse is inserted. This results in a tight clamping contact when fuse clamp switch blades are inserted in switch contact slots.

Fuses slide easily and quickly into place. No adjustment necessary

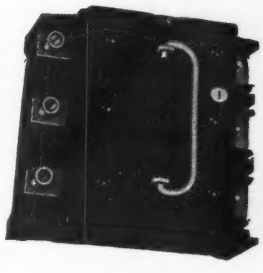
The FA PULFUZSWITCH

insures against loose contacts and resultant overheating . . . The fuse-holding switch blades are so designed that the placing of the fuse carrier into the ON position of the switch automatically *clamps the fuses tight* . . . At the same time, the switch blades make *pressure contact* with the fixed switch parts, insuring full current carrying capacity. . . . These photographs show how this is accomplished.



Note how fuse clamp switch blades, in ON position, make pressure contact with switch contact slots in the base. This draws the tips of the switch blades together, and pulls fuse clamps tightly around fuse ferrule. Contact parts are silver plated, for low resistance and long life. Bakelite barriers isolate each fuse in an individual compartment.

Each unit is equipped with FA solderless type pressure connectors; visible ON and OFF indicators; ventilating holes in fuse carrier; contacts for bus or cable integral with contact slot member, and pull handle for reversing switch.



FA PULFUZSWITCH units are made in 30, 60 and 100 ampere capacities, for 250 volts or less; also 30 and 60 ampere, 600 volts. They are assembled into panelboards (with either single or double row of branches) for all types of feeder systems. 60 ampere branches are convertible to 30 ampere—a desirable convenience for heat and power service.

Boxes are of galvanized steel. Wide gutters and FA Pressure type (Solderless) Connectors expedite wiring. Fronts are rust-proofed, and attractively finished in pearl gray. Available for both surface and flush mounting . . . For further information, write Frank Adam Electric Company, Box 357, St. Louis, Mo.

FA Pulfuzswitch Panelboard, double branch, with 60 amp, 3 pole branches.

EST. 1891 THE SIGN OF A BETTER JOB

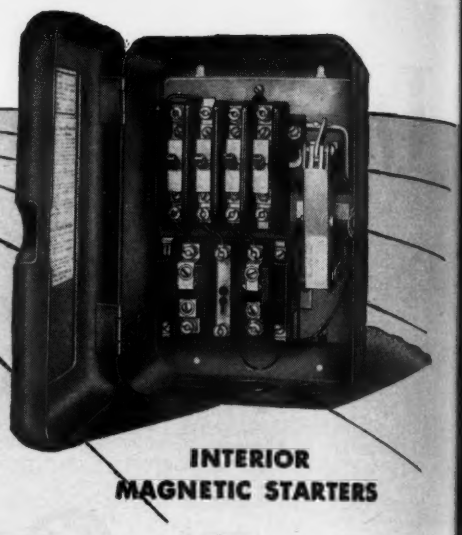
Frank Adam

ELECTRICAL PRODUCTS

for War Industry

FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO. U.S.A.

outward sign



INTERIOR MAGNETIC STARTERS

OF INWARD BETTERMENT . . . IN MOTOR STARTERS

Point by Point . . .

WIDE, COORDINATED RANGE of stock units . . . from "TT" manual starters for small motors to complete multi-motor CONTROL CENTERS.

TRUMBULL-PIONEERED VERTICAL CONTACT design prevents dust and carbon troubles.

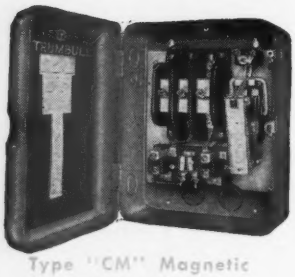
WIRING, INSPECTION, REMOVAL and REPLACEMENT of parts FROM THE FRONT saves installation and maintenance time.

COMPACT, SPACE-SAVING COMBINATIONS include starter and disconnect in same box.

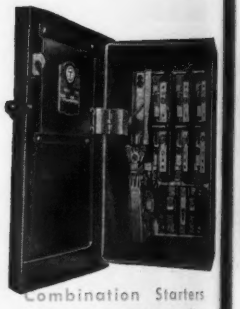
"BUILDING-BLOCK SIMPLICITY" in laying out centralized multi-motor control installations with Trumbull "packaged" stock-unit-type MOTOR CONTROL CENTERS.

Type "TT" Manual Starter for small motors (1 hp max.)

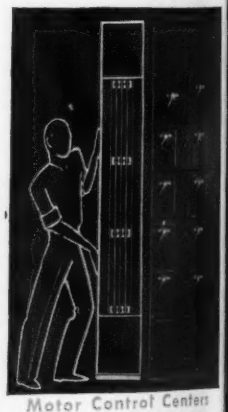
Type "TM" Manual Starters "TM-2", 2 hp., "TM-7-½", 7-½ hp.



Type "CM" Magnetic Starters also Contactors Motor reversing



Combination Starters (Magnetic starter & disconnect)



Motor Control Centers

TRUMBULL

MOTOR STARTERS

• Whether you need a starter for a single small motor or a modern control center layout for an entire production line . . . look to Trumbull. We will be glad to send you Motor Control literature upon request. Ask for Bulletins 404 & 411.

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Remarkably CONVENIENT for

FOR FOUR 40-WATT
FLUORESCENT LAMPS

Yes, Sir . . . right up the line, the Curtis "Warrior" is a popular unit . . . the contractor finds it easy to sell because of its many features . . . the electrician appreciates its flexibility as it is adaptable for a variety of installations, and the customer goes for its attractive appearance, high efficiency and easy maintenance.

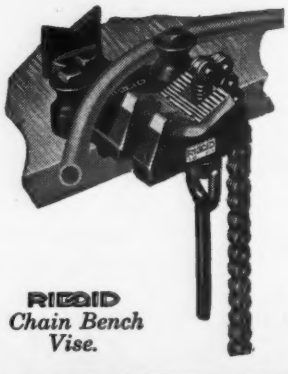
Full details and complete specifications are available in a newly issued bulletin. Write for your copy today.

FOR FOUR 40-WATT FLUORESCENT LAMPS

The New Curtis
"WARRIOR"

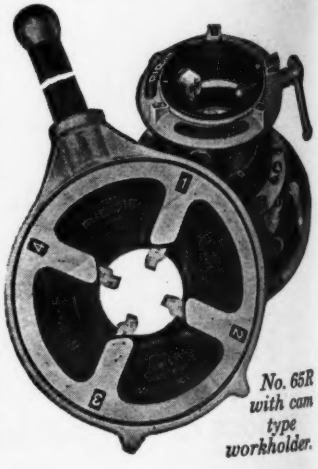
CURTIS *Lighting*, INC.
6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

● Fold in the hinged legs, take it to your job, set it up quickly and you've got an efficient vise *and* a work-bench that stands solid against tipping over, with lots of room for oil can and tools. Feet screw down and there's a ceiling brace, if you need them. Vise has tool steel LonGrip no-mar jaws and pipe rest — and handy pipe benders for three sizes of pipe or conduit. For more for your money, ask for the RIDGID Tri-stand, yoke or chain vise models, at your regular Supply House.



RIDGID *Chain Bench Vise.*

● Spin it up, spin it down—and this modern speedy No. 65R is ready to thread 1", 1¼", 1½" or 2" pipe or conduit—clean accurate threads cut with high-speed steel dies that stay in the threader, no bother with extra sets of dies for each size. Mistake-proof work-holder sets to size instantly, only one screw to tighten. It's a rugged steel-and-malleable tool you enjoy using. For easier quicker threading, better threads and lower tool cost, ask your Supply House for the efficient No. 65R.



No. 65R with cam type workholder.

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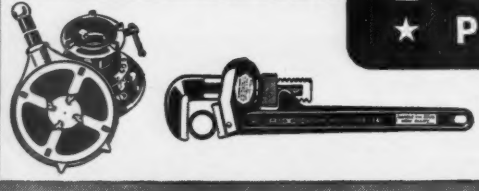
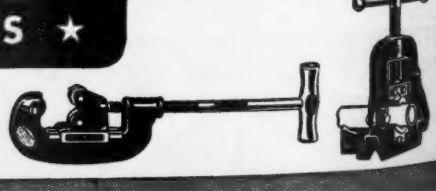
Millions of RIDGID Tools in use





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Elyria, Ohio, U. S. A.

NEW O.Z. DATA FOR PRACTICAL PLANNERS

144 PAGE CATALOG PACKED WITH FACTS *About* FITTINGS

based on 25 years of "Know-How"

Here's an easy-to-use working tool for everyone whose future plans call for electrical fittings. Here are the results of wide pre-war experience seasoned and tested under war-time service conditions . . . the *facts* you need to know about an improved line of O.Z. products including the latest O.Z. developments in

- CONDUIT FITTINGS
- SOLDERLESS CONNECTORS
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NOTE THESE FEATURES ADDED FOR YOUR CONVENIENCE

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COMPLETE DIMENSIONS
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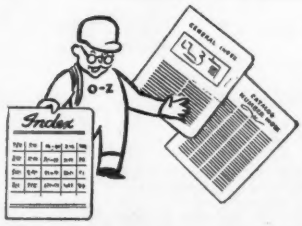
NEW PHOTO-DIAGRAMS
THREE-WAY INDEX—PICTURES, PRODUCT, CATALOG NUMBER



This new catalog gives you timely information in practical form, covering improved products, expanded lines, newly developed lines and reduced list prices. A request on your letter-head will bring you your free copy.

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262 BOND STREET · BROOKLYN, N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

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PROPER ADHESION AND FUSION ARE "MUSTS" IN

PANTHER AND DRAGON TAPES

A FRICTION TAPE serves its function only so long as a proper degree of adhesion exists. When adhesion falls below a minimum, there can be no assurance of a continuously sealed joint. Similarly, in the case of rubber tape, proper fusion is required if each successive layer of tape is to remain firmly bonded to its neighbors. Without a proper degree of fusion, rubber tape offers poor insulation of the joint.

PANTHER and DRAGON Friction and Rubber Tapes are constantly tested at the factory to ensure sufficient degrees of adhesion and fusion.

Fully meeting all the requirements of A.S.T.M. and Federal Emergency Specifications, PANTHER and DRAGON Friction and Rubber Tapes are being specified and used by electrical contractors who recognize the guaranteed performance of *factory-tested* tape.

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10. Colorful, Attractive Boxes

SOLD THROUGH RECOGNIZED INDEPENDENT WHOLESALERS

FRICTION TAPE

1. Guaranteed Footage
2. Substantial Fabric
3. High Tensile Strength
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6. Uniform Thickness
7. Uniform Width
8. Excellent Tackiness
9. Strong, Durable Core
10. Colorful, Attractive Boxes

PANTHER & DRAGON FRICTION AND RUBBER TAPES

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NEWS IN 1898...

An Emerson-Electric Motor Drives a HAIR DRYER

The first electric hair dryer, shown here, was an ingenious combination of a gas burner and a blower driven by an Emerson-Electric motor. Able to dry the heaviest "suit" of hair in 10 minutes, it was a sensation.

1

NEWS IN 1899...

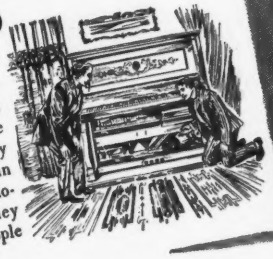
An Emerson-Electric Motor Drives a SEWING MACHINE

An historic event—at the turn of the century—was the development of an Emerson-Electric motor for attachment to the foot-power sewing machine then in use. Women were glad to hail the end of "deadly pedaling."

2

NEWS IN 1904...

An Emerson-Electric Motor Drives a PLAYER PIANO

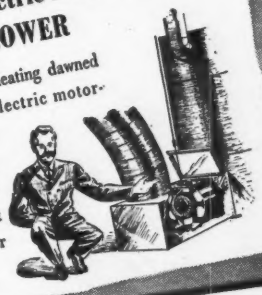


Imagine everyone's surprise when a piano first played itself! This memorable occurrence was made possible by the installation of an Emerson-Electric motor. "What will they think of next?" people asked

3

NEWS IN 1908...

An Emerson-Electric Motor Drives a FURNACE BLOWER



A new day in home heating dawned when an Emerson-Electric motor-driven blower was first attached to a warm air furnace, to distribute the heat uniformly all over the house.

4

News is still being made with *Emerson-Electric Motors*

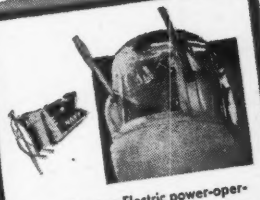
The invention of labor-saving appliances made swift strides after the development of electric motors. Shown above are a few of the many instances where Emerson-Electric worked with manufacturers to make news in the pioneering days. Some of these early ideas blazed the trail for new standards of comfort and convenience—even created whole industries.

Today Emerson-Electric is making news by devoting its 53 years of precision craftsmanship to the creation and production of vital weapons of war, contributing seasoned skill and experience, acquiring invaluable knowledge of new materials and processes.

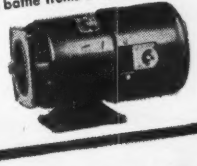
The records of the past prove that there are no frontiers for Emerson-Electric motors. Victory will find Emerson-Electric ready to meet the challenge of postwar America with more efficient motors, to power the new appliances and equipment.

THE EMERSON ELECTRIC MANUFACTURING CO.
SAINT LOUIS 3, MO.

Branches: New York • Chicago • Detroit • Los Angeles • Davenport



Today Emerson-Electric power-operated gun turrets and electric motors for aircraft are in active service on all battle fronts of the world.



EMERSON ELECTRIC

Here's a full-page advertisement which appeared in the February 7th issue of LIFE. It tells the 22,000,000 readers of this magazine something about the tradition behind the Emerson-Electric nameplate—a nameplate that will play an important part in the postwar plans of many manufacturers of motor-driven appliances and equipment.

369

130,000 REASONS

From better See-ability for war work will come higher levels of lighting for everyone—greater efficiency for business and industry, better living for American homes. As soon as materials and manufacturing facilities are available, Westinghouse will lead the way in such lighting developments as: (1) Long thin fluorescent lamps in new shapes and sizes, for store display and feature lighting. (2) A brighter kitchen for lighter work—supplementary light for the sink, inside dark cupboards, over work surfaces. (3) Soft, comfortable fluorescent light in banks and offices for faster, more accurate work. For leadership in lighting, today and tomorrow—watch Westinghouse!

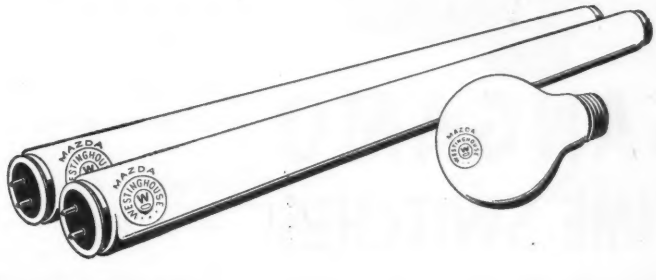
LET'S ALL KEEP BACKING THE ATTACK . . . BUY MORE WAR BONDS!

FOR SEE-ABILITY

Building today's *super-powerful aircraft engine calls for a high level of See-ability. For each giant 2200 horsepower motor made in this plant demands 80,000 machining operations and 50,000 inspections—130,000 vital seeing jobs where improper lighting could mean a serious, delaying error. See-ability—made possible by today's high-efficiency Westinghouse Mazda Lamps—enables workers to combine hairline accuracy with high speed operation, cuts down eye-strain and fatigue. For efficient, dependable service, recommend bright, long-lasting Westinghouse Mazda Lamps.*

Westinghouse Electric & Manufacturing Company, Bloomfield, New Jersey.

Plants in 25 cities . . . offices everywhere.



Westinghouse

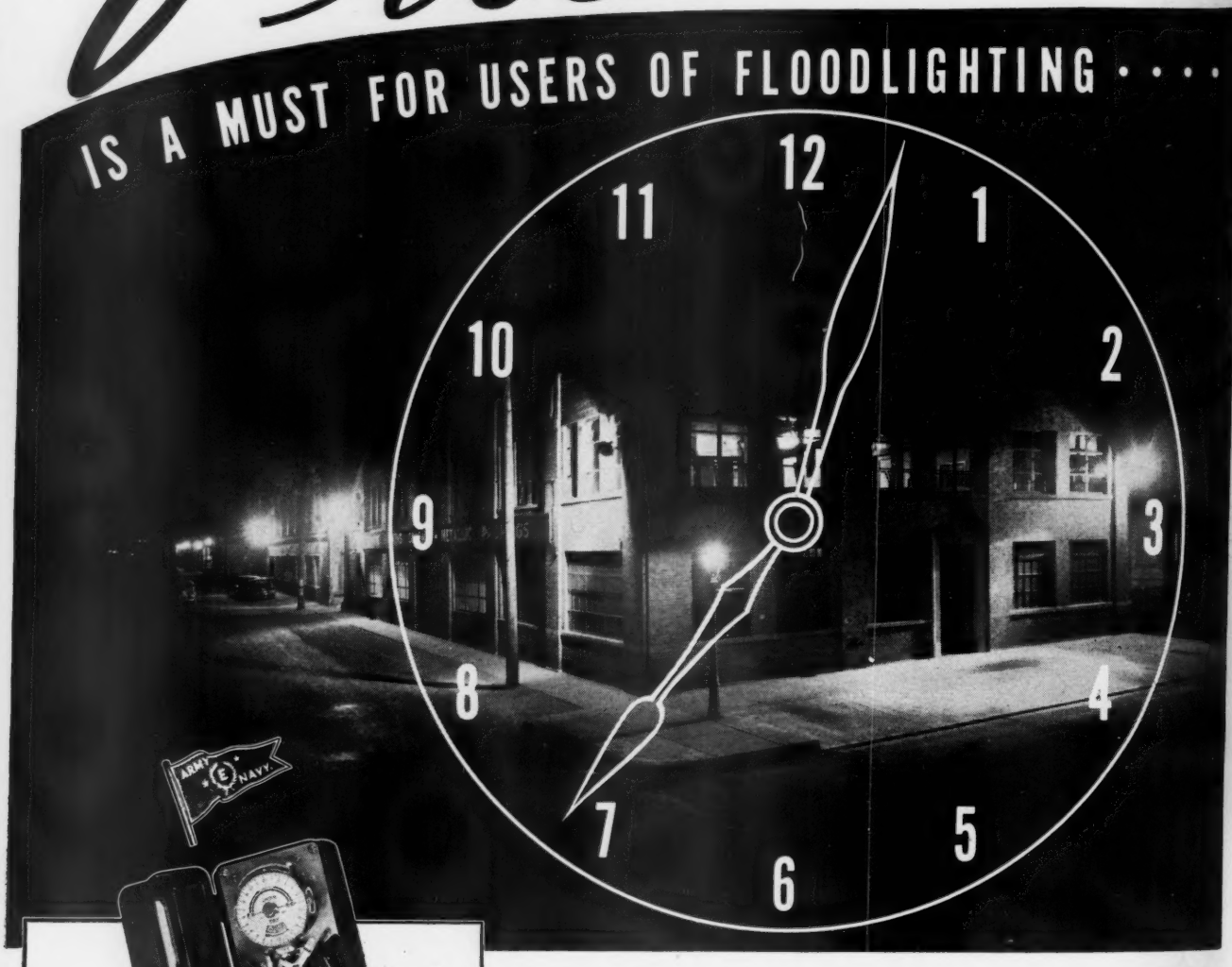
MAZDA LAMPS FOR SEE-ABILITY

Enjoy the Westinghouse radio program with John Charles Thomas, NBC—Sunday—2:30 p.m.—E.W.T.

FULL AND COMPLETE

Protection

IS A MUST FOR USERS OF FLOODLIGHTING . . . .



SANGAMO TIME SWITCHES

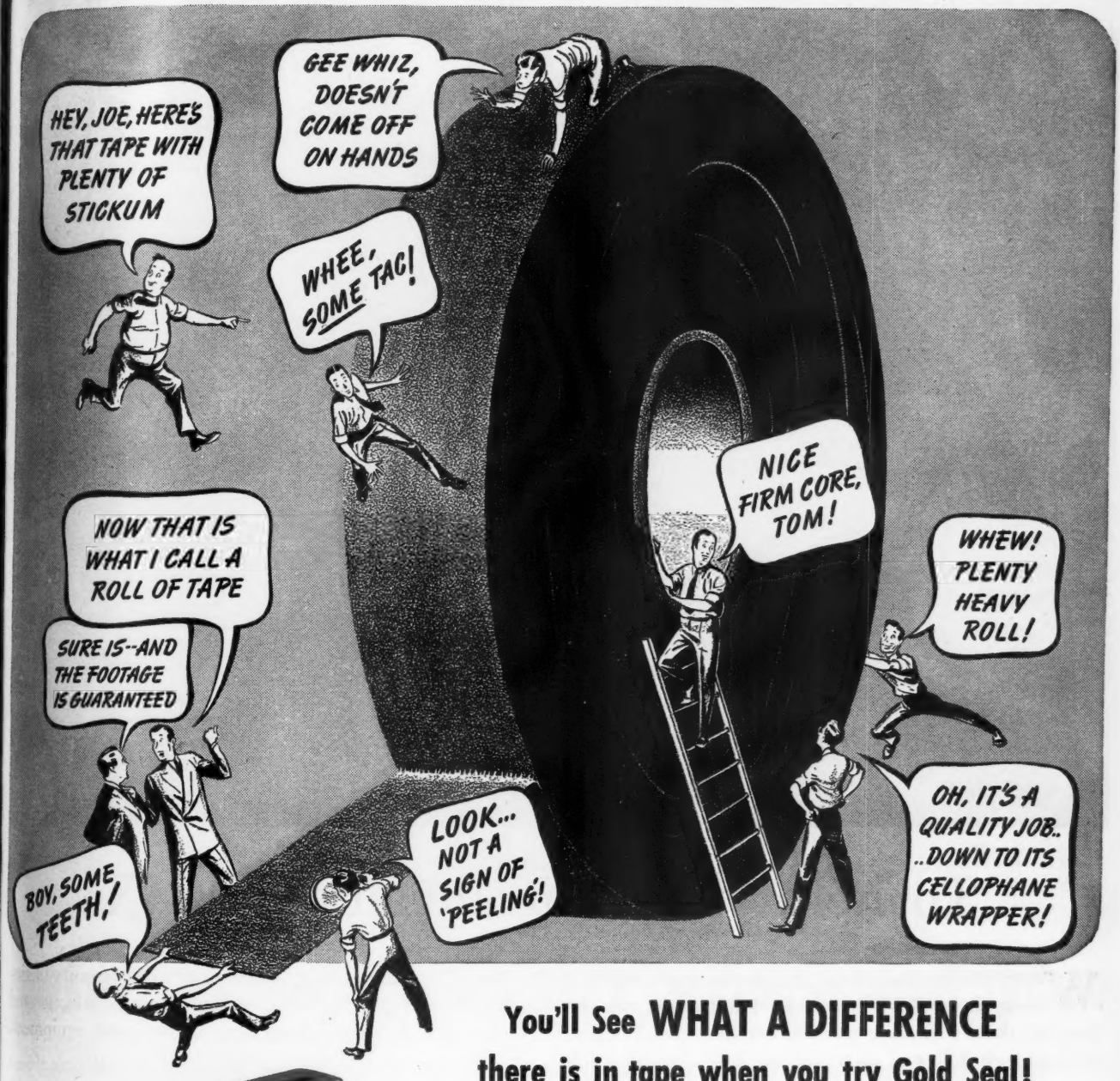
• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSW2 Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

• For every hour of darkness, floodlights must be "on" to secure their full protective value. Automatic Control assures this by turning them "on" at the correct instant and by turning them "off" at the correct daylight hour. SANGAMO TIME SWITCHES do this job, daily, accurately, and without fail, leaving no lap-over periods of darkness that could result through human error.

Where there is a need for floodlighting, there's a sale for Automatic Control.

If you are at the present time completing a floodlight sale—include SANGAMO TIME SWITCHES to give your customer full and complete protection. As a means of new business go back over those past floodlight sales and suggest SANGAMO TIME SWITCHES. Write today for our latest catalog.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS


HEY, JOE, HERE'S THAT TAPE WITH PLENTY OF STICKUM
GEE WHIZ, DOESN'T COME OFF ON HANDS
WHEE, SOME TAC!
NICE FIRM CORE, TOM!
WHEW! PLENTY HEAVY ROLL!
NOW THAT IS WHAT I CALL A ROLL OF TAPE
SURE IS--AND THE FOOTAGE IS GUARANTEED
BOY, SOME TEETH!
LOOK... NOT A SIGN OF 'PEELING'!
OH, IT'S A QUALITY JOB.. ..DOWN TO ITS CELLOPHANE WRAPPER!

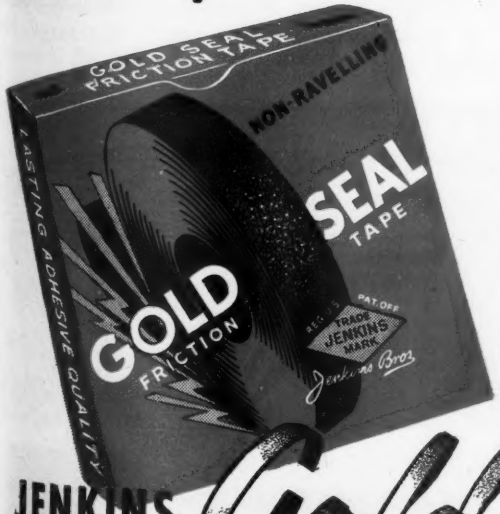
You'll See WHAT A DIFFERENCE there is in tape when you try Gold Seal!

There are "tricks to every trade" – and we believe we use a few that other tape makers haven't heard about. Some of them cost a bit more to put into the product . . . others are "secrets". But – if you could see us make Jenkins Gold Seal Friction Tape, you'd know instantly why this tape gives a tighter, longer-lasting bond . . . why it speeds up work . . . why it doesn't ravel, "peel" and "dry out" like ordinary tape.

A good example of Gold Seal superiority is furnished by the "unwinding test": The Specification Test restricts the pull down rate to 25 inches per minute, but Jenkins Gold Seal Friction Tape cuts that rate in half!

There are other tests just as convincing – but the best proof of all is the "on the job" test you can make yourself! Jenkins Bros. (Rubber Div.), 80 White Street, New York 13, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago.

Other Jenkins Bros. tape products include Diamond Seal Friction Tape, and Diamond Seal Splicing Compound, which meet all ASTM and Federal specifications.



JENKINS

REG. U.S. PAT. OFF. JENKINS TRADE MARK

Jenkins Bros

Gold Seal Tape

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS . . . MAKERS OF FAMOUS JENKINS VALVES

To help you plan ahead for 194X

WHEREVER groups interested in housing get together these days, they discuss the many problems confronting them regarding postwar construction. Because of the inevitability of increased use of electrical appliances and equipment, they recognize that a radically new approach must be taken in planning *electrically* for new homes as well as for the modernization of present homes.

Questions which are raised in planning this important phase of construction are:

What electrical appliances and equipment will be available for homes? Will there be radical changes in prewar models? What will innovations be like?

How should this equipment be arranged in the kitchen, laundry, utility room, living room, bedrooms, and bath—for greatest efficiency?

How about access for servicing? Utility connections? Lighting outlets and controls?

• • •

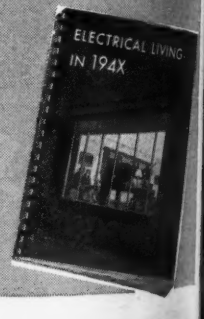
The Westinghouse Better Homes Department is prepared to give you information on these and any other questions relating to the electrical phase of home planning. This Department welcomes the opportunity of giving authentic technical advice on the *proper* selection and planning of home electrical appliances and equipment.

Write: Better Homes Department, Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.

NEW FREE BOOK!

We are preparing a *new and unusual* book which will help you explain to prospective home owners the vital importance of "better wiring for better living" in 194X homes.

Watch for special announcement and free offer of this big 64-page book in the April issue of this Magazine!



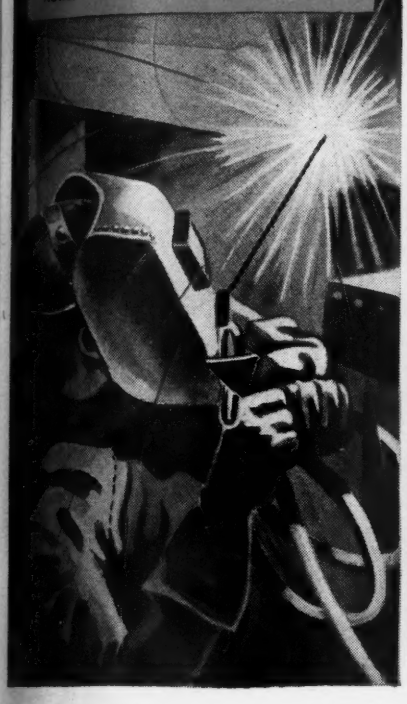
Tune in John Charles Thomas, NBC, Sundays, 2:30 p.m., E.W.T.

Westinghouse

Plants in 25 Cities Offices Everywhere

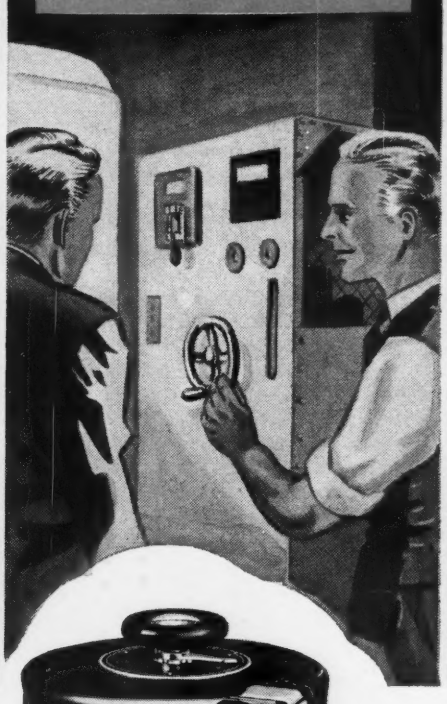
FOR YOUR PLANT

Transtats maintain required temperatures of heating elements or r.p.m. of voltage-sensitive variable speed motors and compensate for line fluctuations.



FOR YOUR PRODUCT

Transtats are neat, compact, and have no projections. They may be specified for rear-of-panel mounting with full assurance of dimensional conformance.



FOR YOUR LABORATORY

Close control plus stability under load changes make Transtats ideal for laboratory work.

PRECISE A.C. VOLTAGE CONTROL

WITH LOW CURRENT CONSUMPTION

For a continuously adjustable voltage or a constant voltage from a fluctuating source, specify Transtat A.C. Voltage Regulators. Their velvety smooth, practically stepless control is unmarred by current interruptions, arcing or line surges. They operate with high electrical efficiency and cannot reduce power factor or distort wave form. With a range from 0 to 100% rating, they may also be connected to provide higher than line voltages. Yet Transtats are no more expensive than many other voltage regulating devices. Write today for complete information covering manual, motorized and fully automatic Transtats. Ask for bulletin 51-2U.

• Cutaway view of a typical TH Transtat showing both outside case and arrangement of parts inside case.

★

AMERICAN TRANSFORMER COMPANY

178 Emmet Street, Newark 5, New Jersey

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

MANUFACTURING SINCE 1893 AT NEWARK, N. J.

(Here's another ad in the series that brings a vital message to your customers.)

In postwar planning...

HOW is just as important as WHAT

NO MANUFACTURER can predict all the new products he will make in the next decade. But he does know that new and improved methods of *producing* them are already here—methods calling for increased use of electric power.

That's why far-seeing management is attaching such importance to *adequate wiring* . . . seeing that it's a basic part of all postwar planning. They realize that tomorrow's competitive position will depend more than ever on electric energy . . . *and adequate wiring to harness it.*

Right now is the time to find out how *your* plant's wiring system measures up . . . what it needs to meet postwar requirements. By all means, bring your electrical contractor and utility power engineer into the advance planning stage. *Unwired* planning will cost you a lot more than *planned wiring.*

ADEQUATE WIRING — KEY TO POSTWAR BUSINESS — SERVES AND SAVES

44224

HELP BRING VICTORY SOONER . . . BUY MORE WAR BONDS

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

Electrical Wires and Cables of Copper are the Life Lines of our Nation

WHAT ABOUT COLD-CATHODE

Announcements have gone out to the trade of new standard length cold cathode fluorescent lamps. Eight foot tubes can be installed by electrical contractors. Reflectors and auxiliary equipment are developed around the new lamps. The custom-made features that have heretofore characterized cold cathode lighting and limited it pretty much to the neon sign people no longer controls its application to lighting. This is a distinct forward step toward bringing cold cathode lamps into our family of useful light sources for interior illumination.

It has been said that the middle of a fluorescent lamp doesn't know whether it is running from hot or cold cathodes. That's right. But there is a difference between hot and cold cathode lighting. It should be faced squarely. Certainly the kind and quality of light from hot and cold cathode fluorescent lamps are practically identical. There, however, the similarity ends. Hot cathode lighting installations involve conventional voltages and wiring considerations. Cold cathode lighting jobs, however, involve radically different methods of wiring, installation and design.

And in the interests of lighting progress, this vital difference should not be ignored, soft-pedaled nor played down. It should be clearly understood that the voltages and currents involved in many of the higher intensity cold cathode jobs can deal out sudden death. It should be clearly recognized that expert installation and highly skilled maintenance are minimum essentials. And these considerations are so important that, in my opinion, the technical distinctions between hot cathode fluorescent lamps and cold cathode lamps are academic by comparison.

What then? Shall we say "To hell with it," and let the sign folks worry about this baby? No! That would be wrong! Illumination is an impressively important phase of electrical work. Cold cathode lamps effectively widen the horizon of lighting methods and application. The inherent viciousness of lethal voltages is a challenge to the ingenuity and skill of manufacturer and installer. It can be controlled. It can be safe.

As first principles, I want to offer the following elementary considerations for the job.

1. Interior cold cathode lamp circuits involving 60 mils and over should include a relay or other device to open the primary current and ground the secondary terminals in the event of a lamp or circuit failure.

2. Lampholders should be designed so that they are inaccessible. The shield or other device should effectively ground the terminal when open.

3. Lampholders should be designed so that a locking device grounds the terminal before releasing the lamp.

4. All high voltage terminals and wiring should be enclosed within grounded metal housings and raceways, sealed mechanically or by soldering or welding so as to be permanently inaccessible except to a skilled mechanic.

5. Cold cathode installations should be subject to annual reinspection by accredited electrical inspectors.

The public will want and will buy cold cathode lighting. They will expect the same standards of safety to life and property that we have always built into electrical systems. The man in the street doesn't know and should not have to care about the characteristics of voltages and current at the point of use. That's our job and our responsibility.

Wm. F. Stuart

Electrical Contracting

MARCH, 1944

BE READY FOR A *Repeat Performance!*

WITH THE HELP OF YOUR GRAYBAR MAN

THE nation's vast program of war-plant construction found electrical contractors well prepared and well qualified. Factories and military establishments were quickly completed and equipped with every *electrical* means to increase their efficiency.

Many electrical contractors on important war projects reported: "The GRAYBAR Man was a great help to us. His experience in selecting the right items, in expediting supplies and overcoming shortages helped make our performance a success."

Today, though the electrical contractor's job is changing, one part of the picture remains the same. Foresighted contractors are maintaining their close contact with GRAYBAR. For the present, this means faster delivery of war-essential supplies. For the future, it means a fully-informed source of information on what's new, what's available and *what's best for the job,* whether it be one of reconverting a war plant, electrifying a new housing project, or even lighting a new helicopter depot.

In your local GRAYBAR office, there is a Representative who will make *your business* his personal responsibility. Why not call him?

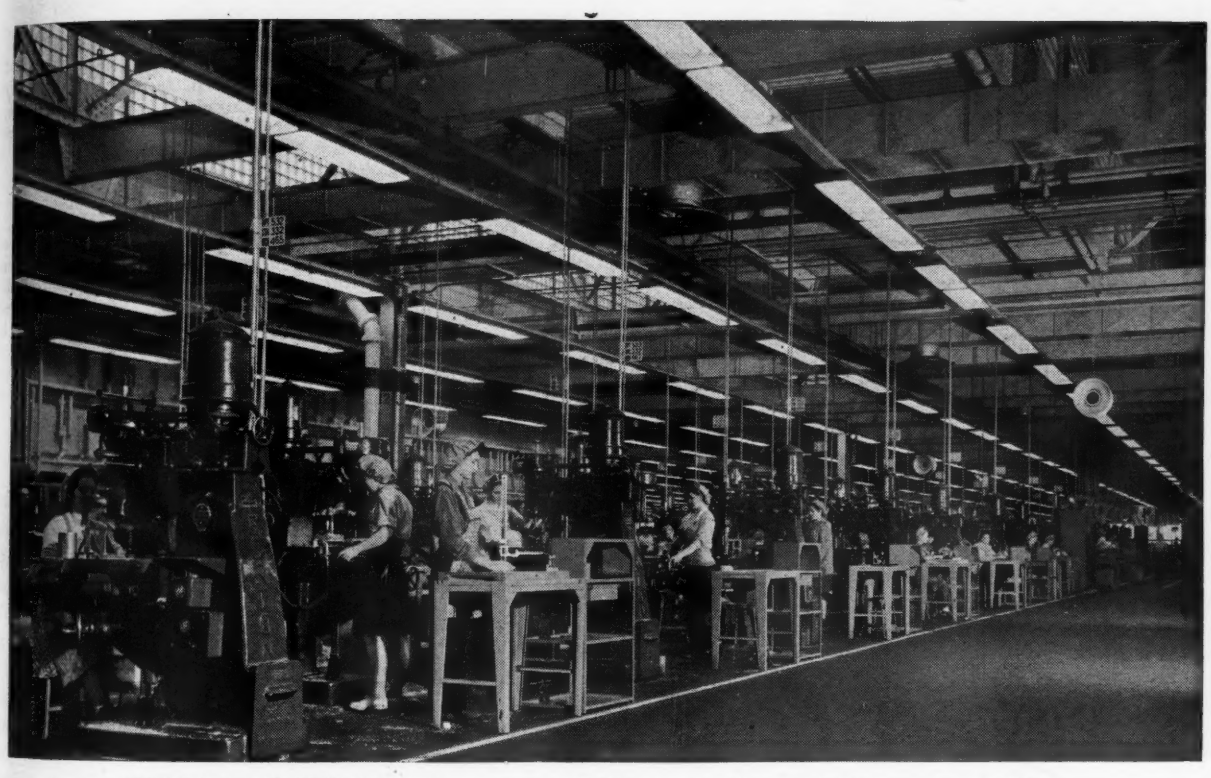
GraybaR

IN OVER 80 PRINCIPAL CITIES

Executive Offices: GRAYBAR BUILDING, NEW YORK 17, N. Y.

GraybaR QUALITY *REG. U.S. PAT. OFF. 75 YEARS OF *Electrical Distribution*

ECONOMICS of Lighting Maintenance



TYPICAL FACTORY AREA showing general illumination provided by fluorescents. Note that close spacing of machinery would make maintenance by ordinary ladder very difficult.

A study at Sperry Gyroscope's new Nassau plant to determine the most economical method and time of lamp replacement to maintain designed intensities.

By J. S. Massell,

Chief Electrician, Sperry Gyroscope Company, Nassau Plant

TO insure against a decrease of illumination levels below a critical zone of 30 to 35 foot-candles, plant engineers of Sperry Gyroscope's new Nassau plant at Lake Success, N. Y. have made an exhaustive illumination survey. Many questions were involved. How often should fixtures and tubes be washed? Should lamps be replaced when burned out, or at the end of useful life? Would group replacement be more economical? If so, at what time should they be replaced? A detailed survey revealed the answers.

The following is a report on the conduct of the survey, the more important conclusions drawn, and the maintenance procedure that has been put into effect.

Since every plant in the country has its own peculiar and individual operating conditions and environments the results of this study may not be universally applicable. However, the procedure and method can be applied wherever there is a problem of lighting maintenance.

For instance, at Sperry's where plant operation is 24-hours, lamps are seldom turned off. Fluorescent lamps in the original building had operated between 5000 and 7000 hours with only 40 percent replacement. There seemed to be no indication that lamps were going out at any such rapid rate as indicated by published mortality curves. Also, lamp depreciation continued on a downward trend rather than flattening out as shown by published data. Further, washing lamps and fixtures after 5000 hours of unmolested operation increased foot-candles only 10 percent due to the cleanliness of the air-conditioned atmosphere required for production. Thus, a section where fixtures had gone unwashed for 5000

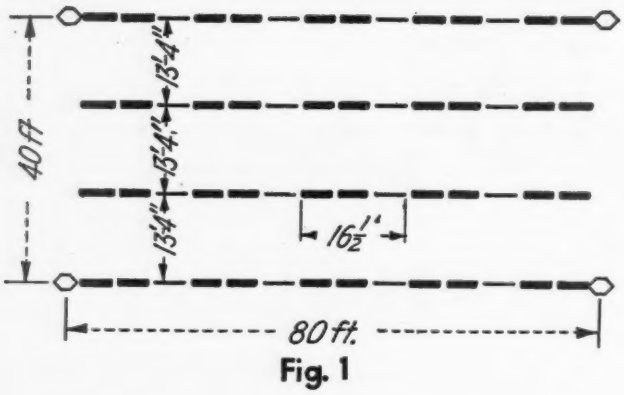
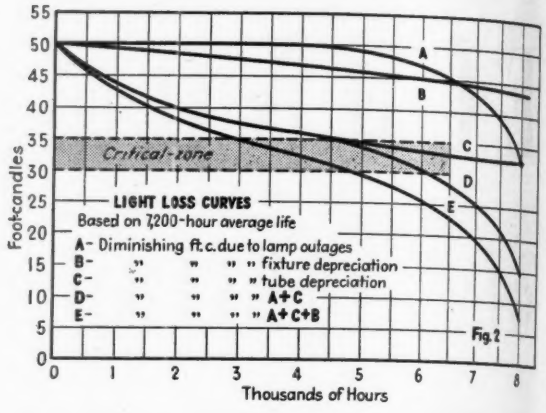


Fig. 1


Footcandles
Critical-zone
LIGHT LOSS CURVES
Based on 7200-hour average life
A- Diminishing ft.c. due to lamp outages
B- " " " " fixture depreciation
C- " " " " tube depreciation
D- " " " " A+C
E- " " " " A+C+B
Fig. 2
Thousands of Hours

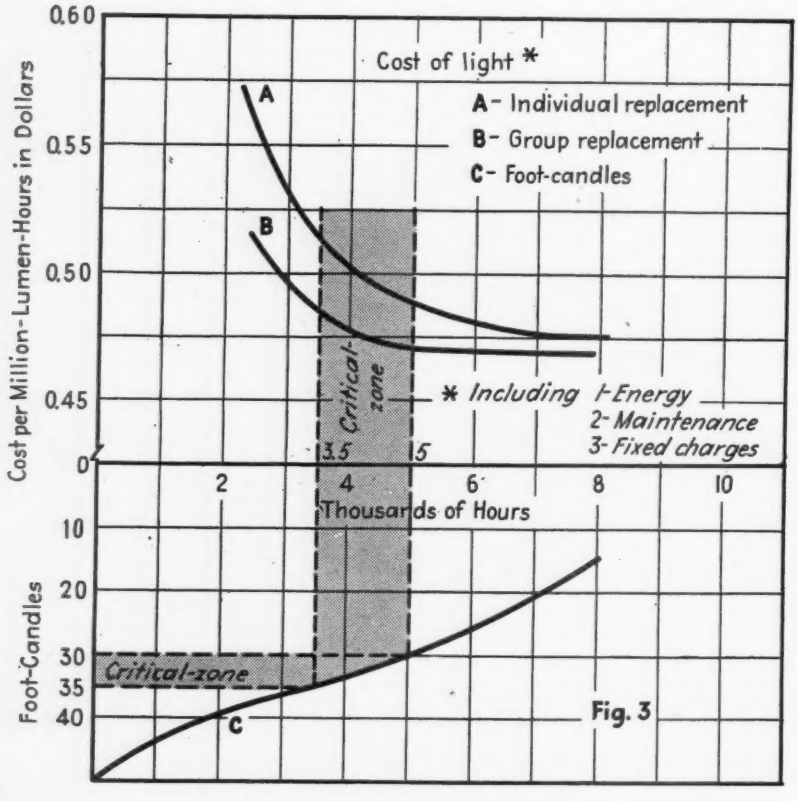


FIG. 3—Curves A and B show that the cost declines in dollars per million lumen hours and finally flattens out at a definite value. The foot-candle curve C is the same as Curve E of Fig. 2. Since a minimum critical zone of 30-35 ft-c. has been established, lamps must be replaced at between 3500 and 5000 hours regardless of which method (A or B) is used.

FIG. 1—Typical layout of a 3,200 ft. section showing fixture spacing. Mounting height is 15 feet. Note provisions for additional fixtures if necessary.

FIG. 2—Light loss curves show foot-candle depreciation over 8000 operating hours. Curve B shows foot-candle losses due to collection of dirt and dust. Curve C shows losses due to decreasing lamp efficiencies. Curve E corresponds to the foot-candles encountered over the operating period by actual measurement.

hours gave a reading of 30 ft-c. Washing only increased this to 33 ft-c; not enough to justify the cost of a washing operation alone. However, by relamping and washing, foot-candle levels could be restored to an initial illumination of about 50 ft-c. and a maintained level (in the case of daylight lamps of about 42 ft-c. This gave respective increases of approximately 67 percent and 40 percent over the diminished value of 30 ft-c. at the end of 5000 hours.

Thus it is seen that every lighting system should be given individual study for determination of maintenance policy.

Every lighting system is designed to give a definite average maintained intensity of illumination. In addition, minimum levels should also be determined. Otherwise, if these values are not given and have no major importance, then we have no basis for a study on the economics of operation. However, once the seeing requirements are established, the study becomes a matter of straight-forward calculations based on the development of obtained data. These include many series of foot-candle readings over the complete life of the tubes under the varying conditions of individual replacement, group replacement, before and after washing tubes and fixtures, etc. Cost considerations will include lamp efficiency, energy charges, fixed charges and replacement handling charges (including washing costs).

All measurements were taken at night. The survey began in the drafting room where glass-covered, flush troffers accommodating two 40-watt tubes were mounted in continuous row on five foot centers with a ceiling height of 12 feet 6 inches. After several hundred hours operation, average maintained levels on the drafting tables measured 65–70 foot-candles.

The survey then proceeded to the factory sections of which a typical section layout can be seen in Fig. 1. Note that fixtures are grouped so that a third fixture may be added for every two already installed, should lighting requirements demand it. Already, in a few sections, these additional units have been installed. Fig. 1 shows fixture spacings for a 3,200 square-foot section. All fixtures are two lamp 100-watt closed-end units. This gives a picture of the general illumination provided. In addition, local lighting is used at all benches and wherever high intensities are required in the order of 100–250 ft-c.

As a typical example of the procedure, assembly sections No. 1 and No. 2 are chosen. In section No. 1, initial readings 30 inches above the floor

averaged 50 ft-candles. Daylight tubes were used and after they had operated well beyond the 100 hour period, spot checks revealed an average of 42-foot-candles. Finally, at the end of approximately 7,200 hours of operation, with an estimated 60 percent of the original lamps still burning (40 percent replaced at various times) the average reading had dropped to 28 foot-candles.

Assembly section No. 2 was identical to No. 1 except that white tubes were used. Readings taken here well beyond the 100 hour period averaged 47 ft-c, showing an increase in maintained foot-candles over the daylight tube of about 5 ft-c. And at the end of 7,200 hours of operation (and under the same conditions of 40 percent replacements) readings still showed higher foot-candles, averaging 30 ft-c. (about 2 ft-c. over the daylight).

However despite the higher lumens output of the white lamps, the daylight lamps show slightly better performance in that the white tube had a total depreciation of some 36 percent while the daylight tube output decreased some 33 percent over a 7,200 hour operating period basing conclusions on the maintained value, i.e. readings taken after 100 hrs. operation.

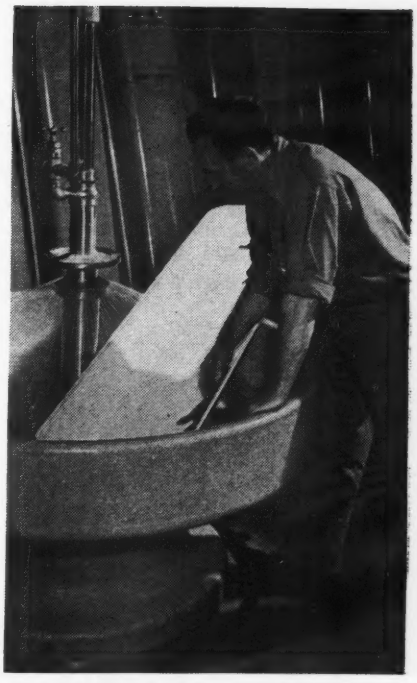
Certain fixtures were allowed to go unwashed over a 5000 hour period. Readings were taken, fixtures were then washed, lamps were washed and re-installed, and readings again taken immediately. The increase in foot-candles amounted only to about 10 percent. This was attributed to the air conditioning the modern exhausting equipment, and the general cleanliness of operations.

This and similar additional data were accumulated and compiled. Because of the longer average life of fluorescent lamps experienced at the Nassau plant, it became necessary to select an arbitrary mortality curve on which to base calculations. After due consideration a 7,200 hour mortality curve was selected. This curve showed that at the end of 7,200 hours, 40 percent of the 26,000 lamps (approx. 13,000 industrial fixtures are installed in the factory area) had burned-out or 10,400 lamps. The curve also showed that in the next 2000 hours, 50 percent more would burn out or 13,000 lamps which is an extremely rapid rate. In addition, the remaining lumen hours of this 50 percent group are the most expensive as far as energy consumption is concerned because of the decreased lamp efficiencies.

Thus it was seen that the cost of individual replacement was beginning to assume huge proportions, and that group replacement should be made at some definite time. Further cost analysis substantiated this and revealed the economic "smashing point".

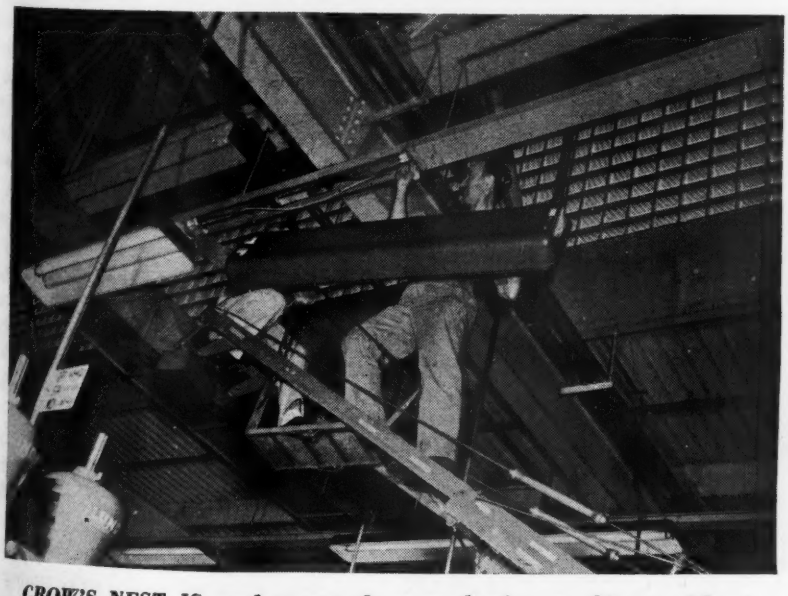
Cost calculations were simplified by reducing fixed charges and energy charges to an equivalent energy charge. That is, annual fixed charges per lamp were estimated and added to the annual cost of energy per lamp including ballast losses and average efficiencies. Thus a figure of 1.062 cents per kwh. equivalent energy rate was derived. Individual lamp replace-

(Continued on page 165)

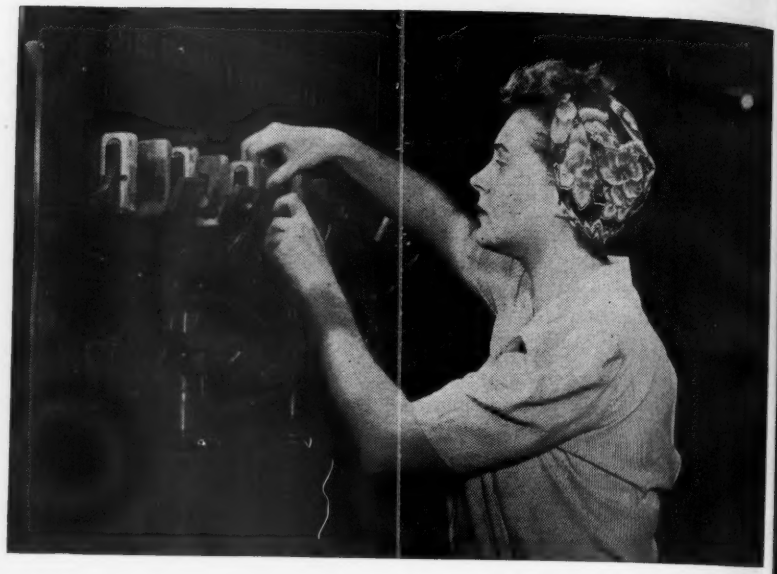


***ONE OF THE MAINTENANCE** electricians demonstrating how the messenger washes fixtures for installation the next day. Note the stack in the background waiting to be cleaned.*

***CONTINUOUS STRIP**, glass covered flush troffers provide a maintained level of illumination between 65 and 70 foot-candles*

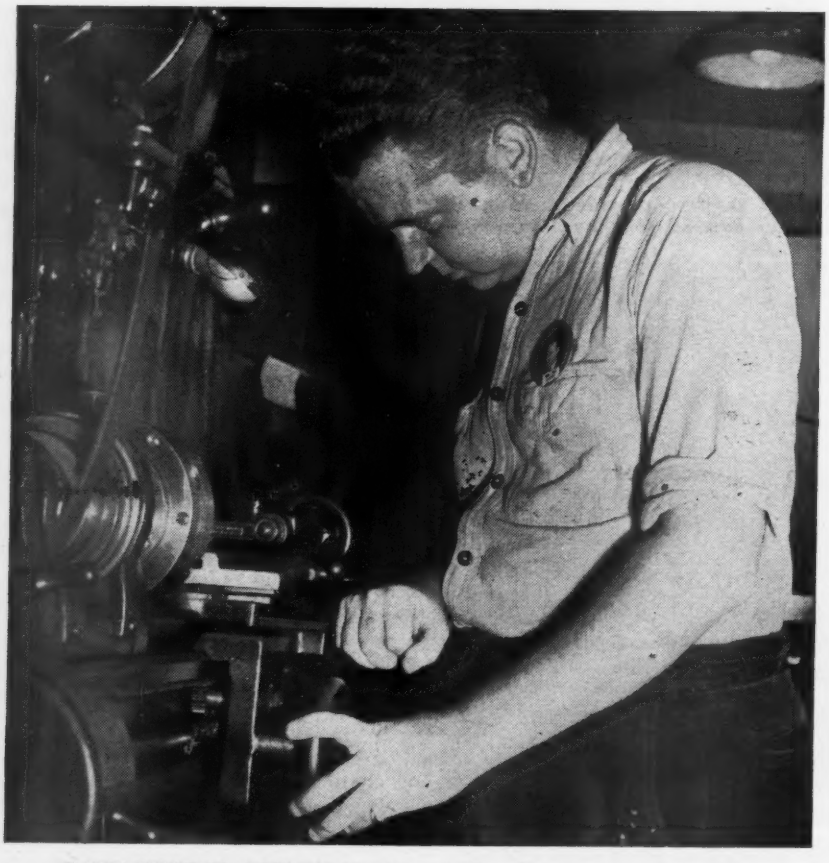


***CROW'S NEST IS** used to get above production machinery without interruption to operations. Sockets are given final inspection for tightness before replacing clean fixture.*



***CONTACT SURFACES,** arc-barrier condition, connections, alignments, etc. are carefully checked in routine procedure each day.*

WOMEN for Maintenance



***EACH SHOP IS EQUIPPED** with a lathe, drill press and various other necessary tools to meet the maintenance requirements.*

IN replacing men called for the service, one of New York City's large buildings trained women for elevator maintenance. The result has been very gratifying according to the chief mechanic who has direct supervision of the work.

As can be seen in the accompanying photographs, the equipment is of ancient vintage requiring careful and thorough maintenance and inspection. All the equipment is still in exceptionally good condition due in large part to the preventive maintenance and inspection program that has always been carried out on a strict schedule.

The electrical staff consists of a chief mechanic having supervision over all the buildings; day shift electricians and helpers; and night shift electrical mechanics and helpers. The number of mechanics and helpers on each shift and in the various buildings depend upon the number of elevators and the condition of the equipment. In the building where these pictures were taken, there are eleven passenger and freight elevators—all in good condition. This inventory of equipment condition includes cables, cars, rails, control, motors, etc. The manpower requirements are one electrician and one

Metropolitan Skyscraper Employs Women Helpers to Maintain Elevator Equipment.

helper on day shift, and one electrical mechanic and two helpers on night shift. Flexibility is derived from the fact that each building has similar staffs, and if the necessity arises, schedules can be changed, and men shifted to handle big over-haul jobs. In emergencies, personnel can be called in from other buildings to render assistance.

Each building keeps its own stock of replacement parts. Each has its own shop with tools, engine lathe, and drill press.

From time to time, the chief mechanic sends out revised inspection and maintenance procedures. In general, however, the day shift does only minor inspection and maintenance of a temporary nature. They locate trouble and fix it temporarily until the night shift can make a permanent job of it.

The night men work on a little stricter schedule. Since the elevators are not in use, the night men carefully inspect all equipment each night in a routine manner. To assist this inspection, the day man in charge always leaves a report on any unusual occurrences such as a sparking commutator, flashing contacts, sluggish solenoid operation, etc. Brake adjustments, contact surfaces, oil levels, commutators, connections, solenoids, etc. come under this daily inspection procedure.

Every six months the control and contact board of each elevator is torn down completely to the last bolt and nut. Each part is thoroughly cleaned and inspected. Worn parts are replaced and the board is reassembled. In this way parts such as pins, bearings, bushings, pig-tails, contacts, springs, etc. that are impossible or hard to get at, can be inspected and replaced if necessary.

At the same time, other parts of the equipment such as safety devices and brake-linings are checked and can be replaced. Commutators are dressed periodically and undercut without removing the armature from the stator.

Such a program places a heavy burden of responsibility upon each individual, especially when staffs are small. The women have replaced the men man-for-man and are doing a splendid job in carrying their share of this maintenance responsibility.

***WOMEN HELPERS** have proved themselves capable in inspection procedures and repair work. The girls can handle maintenance tools almost like any expert.*

***LOOSE CONNECTIONS** are tightened. Each accelerating contactor is equipped with five contacts operating at various air-gap adjustments to provide timed-sequence operation.*

ENGINEERING D

Advances in design and application of electrical equipment reported at A.I.E.E. technical meeting mark new milestones in industry progress.

THE effect of mutual heating of cables on current rating was the subject of a paper that attracted much attention and discussion from engineers the country over gathered at New York City, A.I.E.E. headquarters for the annual winter technical convention. The paper was based on a series of tests using conduits grouped on standard dimensions and under conditions simulating free dissipation, side restriction but vertical dissipation, and an enclosure restricting dissipation.

Another paper dealt with a control scheme for thyratron motor control by which the rectifier functions as an inverter, decelerating the motor by regeneration. Then, acting as a rectifier accelerates the motor in the reverse direction. By this method, armature current can be held at a constant value at less than rated amperes and can stop the armature faster than plugging.

Among other subjects covered were single phase motor windings, current limiting power fuses, supervisory control of industrial distribution including low voltage feeders, induction heating, and transformer loading by temperature.

Significant as picturing recent electrical engineering progress the following abstracts give some of the highlights of important papers presented at the meeting. Complete papers are available from A.I.E.E. for a small fee.

Current Rating of Cables As Affected by Mutual Heating in Air or Conduit

The current rating of cables is determined, in addition to its inherent characteristics, by its surroundings. The cable may be exposed in air, drawn into conduit in air, buried directly in the ground, or drawn into a duct in the ground. It is rarely necessary to consider a single cable; that is, it is customary to install a number of cables in a group. Thus, instead of a single cable dissipating its heat to the surroundings, the problem becomes more complex because of heat being dissipated from each cable on all cables in the group. Therefore, the current rating for a single cable must be modified. Thus heating constants obtained from experimental data are added to the thermal resistance of a single cable for each additional cable.

This new research consisted of taking 1- and 4-inch standard conduits in groups of 1, 3, 6 and 9 with standard spacing between conduits, inserting in each conduit a twisted pair of No. 19 AWG hotbed heater wires and applying various amounts of heat (watts per foot) to obtain a curve of temperature rise of the conduit above ambient temperature. As it is important to know the effect on the heat dissipating properties of the conduits when conduits are installed close to a wall, near ceilings or in completely covered runways, tests were made with conduits freely open to the air; with barriers of paper board about 4 feet high, spaced about 2 feet from the conduit; and with barriers and covers, the latter about 2 feet above the conduits. These three conditions simulated free dissipation of heat, side restriction but vertical dissipation and an enclosure restricting heat dissipation. (Test methods are shown in appendices.)

The effect of groupings is very definite for a given watts per duct foot and the differences between free dissipation, side restricting and enclosure restricting are not great.

The allowable conductor temperature in a cable determines its current rating. Therefore, it is obvious that the watts per foot of conduit must decrease as the number of conduits in a group increases to give the same temperature rise of the conductor. It was, therefore, decided to study the variations in the number of watts per conduit foot for the same conductor temperature rise.

The obtained data disclose some intnteresting information provided we do not try to be too exacting. This will be found to be justified when one considers the manner in which the data will be used.

(A) There is not a great deal of difference in the ratio of the watts per foot for a group to the watts per foot for a single conduit for a given arrangement of conduits and a specific temperature rise, between the conduits in the "open", "isolated", or "isolated and covered". This is fortunate as it simplifies the problem because it can be assumed that all are alike and, therefore, the same correction will apply for all cases.

(B) There is an increase in the ratio with an increase in the temperature rise, due, no doubt, to the increase in air convection currents. This, too, is helpful, as the ratio for, say, a 10°C. rise may be taken knowing that if the cable is designed to give a higher temperature rise of the conduit, the values for grouping based on 10°C. rise will result in conservative ratings.

DEVELOPMENTS

(C) There is not a great deal of difference between the ratio for a given case of 1 inch and 4 inch conduits for the conditions of installation, namely, the standard spacing of conduits. This is helpful for it means factors set up are applicable to any size conduit.

(D) It is obvious that as the spacing between conduits is increased, the influence of conduits on each other will decrease. These tests probably represent the closest spacing likely to be encountered. Larger spacings will permit higher currents and if conditions warrant, should be made the subject of special investigation.

(E) As one wishes to make it as simple as possible in calculations, average values must be selected such that any errors are on the conservative side. Also, they should be easily applied.

Some conclusions are suggested, such as, avoid if possible vertical grouping of conduits, staggering if necessary. Avoid loading up inside conduits and get the benefit of the better heat dissipation from outside conduits.

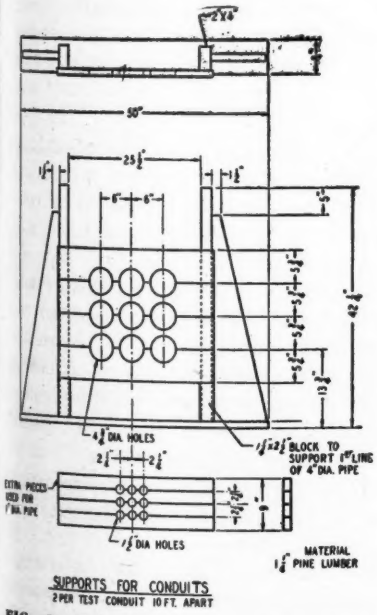


FIG. 1—Supports for conduits were used to get standard spacing for test runs.

Thermal Protection of Transformers Under Overload Conditions

Overloads may be obtained in close agreement with the recommended emergency overload curves by the use of a relay which is controlled by a specially designed heating coil or by a specially designed relay with a conventional heating coil. Since a relay operates at about the same temperature for ultimate conditions, the relay and heating coil must have such characteristics that it will permit the transformer hot-spot temperature to reach considerably higher values for short times than for ultimate steady-state conditions. A detailed study of this problem has shown that this may be satisfactorily accomplished by the use of a lagged heating coil which has a relatively large time constant in comparison with that of the transformer winding, or by the use of a heating coil the time constant of which is about the same as that of the winding for operating a relay that is compensated for the changes in ambient temperature.

This relay which has been developed can be set to perform three separate functions: control fans, give a warning signal, and sound an alarm or if desired trip the transformer off the circuit.

Heating Non-magnetic Electrical Conductors By Magnetic Induction

Heat can be generated in a piece of metal or other conducting material by wrapping a coil around the piece such as the cylinder shown in 1a of Fig. 2 and causing a current of suitable magnitude and frequency to flow in the coil. The great advantage of this type of heating is that the heating can be accomplished without contacting the piece to be heated. This allows the heating to be accomplished while the piece is moving or enclosed in a protective atmosphere. Also the heat can usually be concentrated just where it is needed, and a piece can usually be heated faster by induction than by any other method. The desirable frequency to use for induction heating depends on the size and the electrical properties of the piece to be heated and may vary from 25 or 60 cycles per second for heating joints in iron pipes, to a few million cycles per second for heating very small non-magnetic pieces for soldering. Frequencies up to 10,000 cycles per second are generally obtained from rotating machines; for higher frequencies one must resort to spark oscillators or vacuum tube oscillators.

Some of the applications require the heating of magnetic material such as iron and steel which, in general, are easy to heat. Others require the heating of non-magnetic materials such as brass or copper which can be heated less readily especially when the piece to be heated is small and has a low electrical resistivity.

Almost any problem in induction heating can be resolved into the problem of heating a cylinder, heating a flat slab or strip, or the heating of a surface by a current-carrying conductor near the surface. Methods of solution for these three cases should, therefore, enable one to calculate any problem where the material to be heated is non-magnetic.

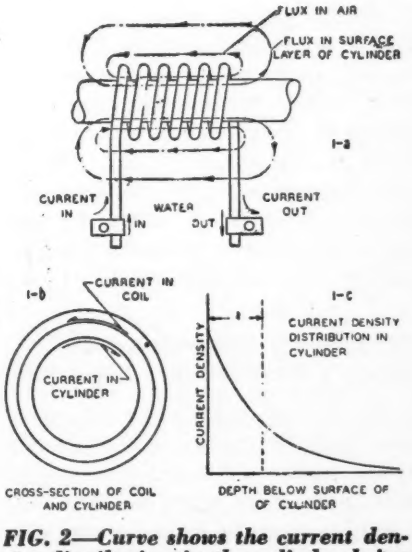


FIG. 2—Curve shows the current density distribution in the cylinder being heated by induced currents.

Inverter Action on Reversing of Thyratron-Motor Control

The rectifier circuit which normally supplies power to the armature of the motor can, with proper control, be operated as an inverter to decelerate the motor by regenerating the rotational energy of the motor and its load into the a.c. system. The circuit then shifts to rectifier operation to accelerate the motor and load to the preset speed in the reverse direction.

The armature current can be held very nearly constant over the full reversal operation of deceleration and acceleration at a value which can be made less than the rated motor current. Test results and theory show that the motor's inherent reactance is sufficient for inverter operation and that during normal inversion, commutation of the tubes is not difficult.

In addition, inversion can be utilized to bring the motor to a stop more efficiently than by plugging and more rapidly and efficiently than by dynamic braking.

The thyratron tube rectifier operating a motor is in some respects comparable to the Ward-Leonard drive, but it has at least one important difference. The rectifier, unlike the generator, is a unidirectional conductor. It will conduct current in only one direction. Therefore, if the rectifier output voltage is reduced, the generated voltage of the motor cannot reverse the current through the circuit. Since the current through the motor armature circuit must be reversed to reverse the direction of the motor torque, the armature connections must be reversed mechanically with respect to the tube circuit. To suddenly reverse connect the rotating motor armature into the "full-on" rectifier would amount to plugging with short circuit current. This would be, to say the least, highly undesirable from the standpoint of the tubes, motor commutation and the connected load. However, by proper control, the tube circuit may be made to invert the d.c. power generated by the motor into the a.c. lines at a controlled rate.

Supervisory Control for the World's Most Modern Steel Mill

For the first time in the history of steel mill design, the entire electric power supply and distribution system will be under the supervision and control of a centrally located power dispatcher. Particularly significant is the fact that all apparatus in the mill

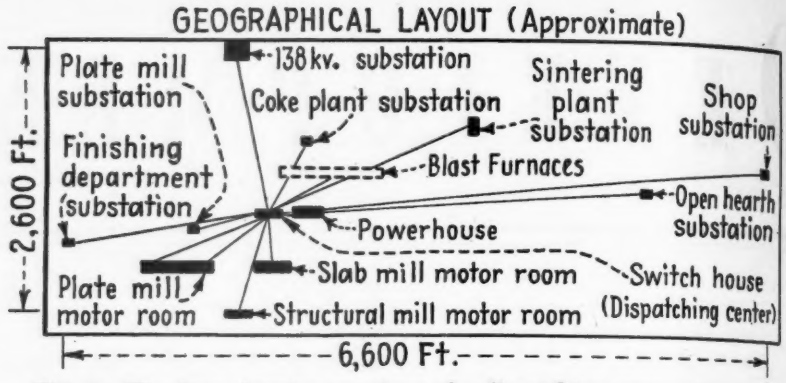


FIG 3—The lines fanning out from the dispatching center represent the independent supervisory control channels used in a West Coast steel mill.

motor rooms likewise will be remotely controlled and unattended.

Supervisory control is a selective code system designed to provide remote control and supervision of a relatively large number of apparatus units through the medium of a single pair of control wires for each remote station. This system utilizes telephone type relays throughout and operates from a battery source of 48 volts d.c. It is simply a means by which remote station apparatus can be supervised and directed just as a substation operator is directed by telephone.

Each unit of the project is provided with an entirely independent supervisory control set-up as in the accompanying diagram. Although all dispatching office equipments are located at a common point, operations can be performed or signals received over all equipments independently.

With the power supply system for the mills literally at the fingertips of the dispatcher, all motor room apparatus can be placed in service with an absolute minimum of manpower and in a minimum of time. Supervisory control provides immediate notice to the dispatcher of the loss of any normal power source. Standby tie lines between substations and between motor rooms can be switched in with minimum interruption to plant production. Provision is also made for the dispatcher to control system power factor to maintain maximum operating efficiency.

In this plant, there are 11 control centers and approximately 500 control points, with provision for an additional 200 future control points. In general, all 138 kv., 13.8 kv., 6.9 kv., 2.3 kv. and 460 volt, 60 cycle circuits, as well as the 250 volt d.c. circuits, are controlled by the supervisory control system. The 250 volt d.c. circuits throughout the plant are supplied from ignitron type rectifiers with semi-high speed heavy duty steel mill type circuit interrupters.

All remote stations and mill motor rooms are normally unattended and the entrance doors are locked. The dispatcher is provided with continuous supervision of each of these door locks. A special contact is actuated by the door lock mechanism and is independent of the actual door position. Thus, once the door is unlocked, maintenance men may go in and out without actuating the alarm.

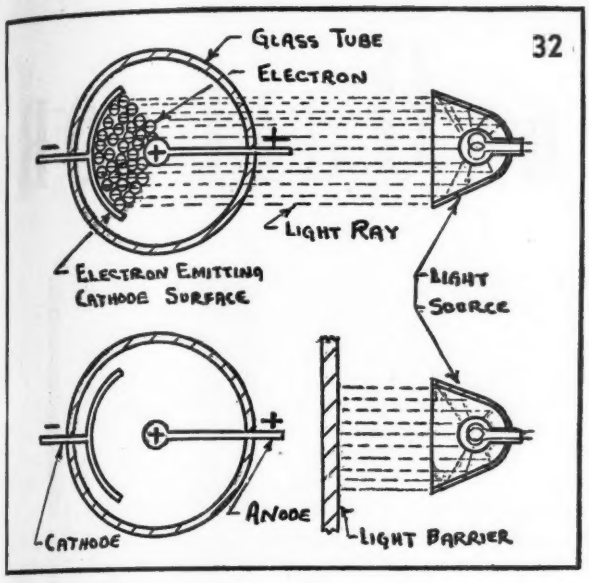
Maintenance men will be required to check in with the dispatcher by telephone when entering a remote station and again when they are ready to leave. The door lock supervision feature provides a final check to make certain the station door is left locked.

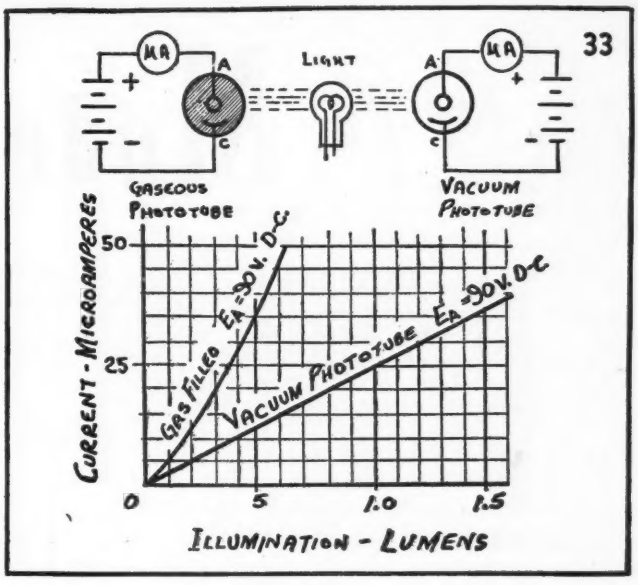
Starting Windings for Single-Phase Induction Motors

Calculation methods given in this paper supply the designer with a tool for computing the starting performance of any given winding; they also enable him to determine the particular auxiliary winding best suited to meet any given set of requirements. In this paper, use is made of the equivalent-circuit concept so popular in technical writing. Also, use is made of the concepts of *open-circuit reactance* and *short-circuit reactance*.

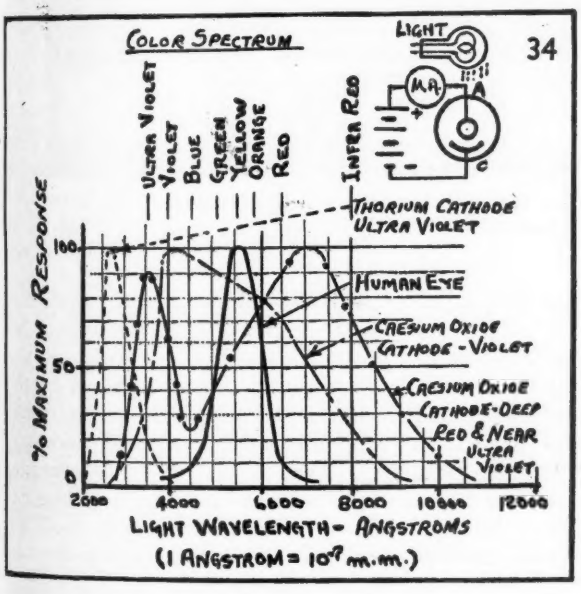
Starting Windings for Split-Phase Induction Motors. The design of the main, or running, winding is usually fixed by considerations of efficiency and breakdown torque. The problem generally is to find the best possible companion starting winding. It is not recommended as a routine design procedure to use circle diagrams; algebraic equations are better suited to this purpose. However such equations may be developed from diagrams. First, from the diagram, two distinct starting windings will be recognized:

[Continued on page 167]





Fundamentals of Electronic Tubes..No. 5



Concluding a series on the characteristics of electronic tubes, this article discusses the operation of the light sensitive phototube.

By Ralph B. Immel
Control Engineer
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

ONE of the most useful of the electronic tubes for industrial use is the light sensitive phototube. It can react to superficial characteristics of passing objects without physical contact for sorting or defect rejection. It can guard dangerous machines. And through amplifiers and relays control power from variation in light beams.

6. *Phototubes—Photo-Electric Emission*

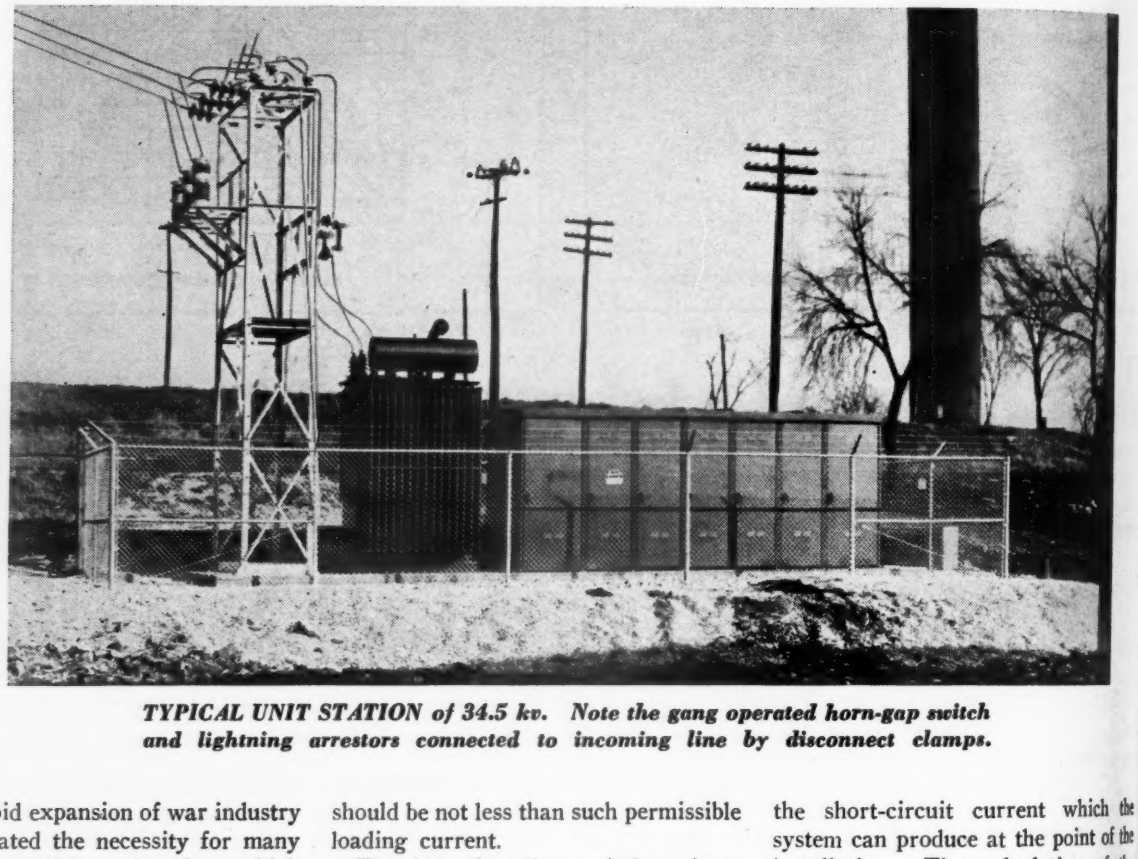
Certain alkali materials such as metallic oxides of sodium, potassium or caesium will emit electrons when they are subjected to visible or invisible light. This characteristic of the material makes it possible to convert light energy into electrical energy. Electrons liberated in this manner are known as photo-electric emission.

A typical phototube usually has two electrodes, a semi-cylindrical cathode and a central anode, sealed in a glass tube. A typical cathode may consist of a silver base metal which is coated with caesium oxide. The caesium oxide is a light sensitive material and one of the best electron emitters among the oxides previously mentioned. The anode usually consists of a straight wire electrode which is mounted in the tube in such a position that its axis coincides with the axis of the cathode. The anode is usually maintained at a positive potential so that the electrons which are emitted from the light radiated cathode may be attracted to it. The movement of electrons from the cathode to the anode constitutes a minute current in the order of microamperes which may be used to control some other electronic device.

Fig. 32 illustrates the emission of electrons when the cathode is exposed to light energy. No electrons are emitted from the cathode when it is not subjected to light. The speed of response or the time for conversion of light energy to electrical energy is al-

[Continued on page 170]

Modern Outdoor



TYPICAL UNIT STATION of 34.5 kv. Note the gang operated horn-gap switch and lightning arrestors connected to incoming line by disconnect clamps.

THE rapid expansion of war industry has created the necessity for many compact outdoor substations which can be easily obtained and quickly installed with a minimum amount of material and labor. Simple prefabricated unit substations with 3-phase transformers rated up to approximately 5000 kva, for primary voltages up to 69 kv. provide an economical means of supplying power to industrial plants.

The incoming line switch must be capable of interrupting the transformer exciting current. Preferably, it should be mechanically interlocked with low-voltage bus circuit breaker to prevent the possibility of opening the switch under load conditions. A triple-pole horn-gap switch horizontally mounted on the top of a structure and operated from ground level is usually recommended for this service. The current rating of the switch should be at least equal to the normal current of the unit substation transformer or a minimum of 200 amperes. In case the transformer is suitable for loading in excess of its rated current for periods of one or two hours or longer, the switch rating should be not less than such permissible loading current.

The incoming line switches, fuses and bus supports should be selected with NEMA standard voltage ratings which correspond to the line-to-line voltage of the circuit. Standard ratings are 7.5, 15, 23, 34.5, 46, and 69-kv.

The interrupting rating of the high-voltage fuses must be at least equal to the short-circuit current which the system can produce at the point of the installation. The calculation of the short-circuit current involves certain data in regard to the power supply system and hence it is usually necessary to obtain the calculated or estimated value from the company furnishing the power. This information should always be given to the manufacturer at

Arrester Max. Line-to-Ground Voltage, KV.	CIRCUIT VOLTAGE RATING, KV.			
	Solidly Grounded Neutral Systems		Ungrounded-Neutral Systems	
	Minimum	Maximum	Minimum	Maximum
3	3	5	1	3
6	5	9	3	6
9	9	12.8	6	9
12	12.8	15	9	12
15	15	18	12	15
20	18	25	15	20
25	25	30	20	25
30	30	37	25	30
37	..	..	30	37
40	37	50	..	..
50	..	..	37	50
60	50	73	..	..
73	..	..	50	73

DISTRIBUTION TYPE arrester ratings for two circuit conditions at various circuit voltage ratings in kv.

INDUSTRIAL SUBSTATION

Prefabricated units permit quick installation with a minimum of materials and labor.

By
E. A. Williams, Jr.
General Electric Co.

the time bids are requested. The same holds true when incoming line power circuit breakers are used for many utilities have established the type of breaker required for connection to their systems at various locations.

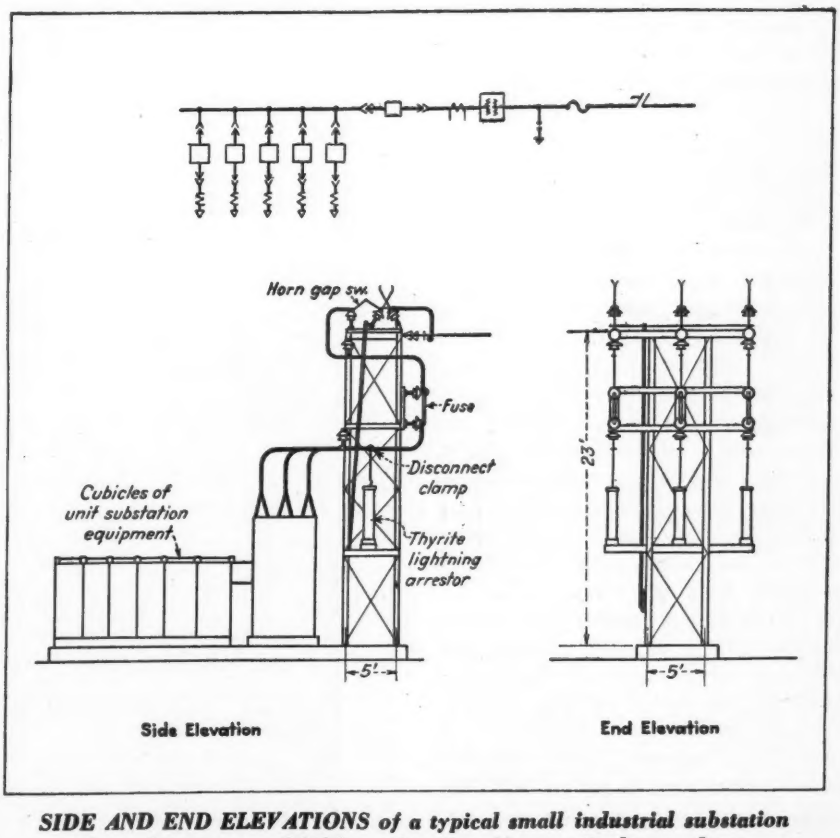
If possible, the continuous current rating of the fuse should be chosen with due regard to the selectivity of the fuse (overcurrent operation) with the operation of other protective devices as well as to normal current in the circuit. That is, it is always desirable to provide a primary fuse with an ampere rating sufficiently high to give the secondary circuit breaker time to interrupt a fault in the secondary circuit before the primary fuse blows. This can be accomplished by comparing the manufacturer's time-current curves applicable to the devices involved. The fuse manutacturer is usually in a position to assist with the proper fuse selection. If the time-current curves of the various devices cannot be readily obtained, an approximate rule of thumb is to select a fuse with a continuous current rating equivalent to twice the normal current of the transformer.

Protection against lightning may be obtained through the use of either distribution-type or station-type lightning arresters, the choice between the two types depending on the degree of protection that can be justified for the particular installation. Some means for disconnecting the arresters should be provided. The most economical arrangement consists of disconnecting clamps as illustrated.

The lightning arresters, unlike the other devices, are voltage sensitive and should be selected with due regard to the system connections as well as to the line-to-line voltage of the circuit. With delta or ungrounded neutral systems, the arresters should be selected with a maximum line-to-ground rating at least equal to the maximum line-to-line operating voltage of the system. With solidly grounded neutral systems the arresters may be selected with a lower voltage rating to give better protection at a lower cost. The ratings of distribution type arresters recommended for the two circuit conditions are given in the table. Station-type Thyrite arrester ratings follow a similar pattern, although the range in circuit voltage to which any given arrester may be applied is somewhat narrower.

The metal-enclosed unit substation equipment is completely factory assembled, ready to install. All parts are selected and coordinated by the manufacturer from general engineering data furnished by the purchaser. The necessary data include: circuit voltage and frequency, transformer capacity, circuit breaker interrupting rating, number and size of feeders.

The prefabrication of the high-voltage structure, either wood or steel, is also an important feature because it relieves the industrial purchaser of the necessity of selecting and arranging devices and makes installation easy. The arrangement shown is for a typical 34.5 kv. unit station, and provides maximum accessibility of the various parts of the equipment. Other arrangements occasionally will be required and it is wise to submit a one-line diagram of connections when specifying complete outdoor substations.



***SIDE AND END ELEVATIONS** of a typical small industrial substation for voltages up to 34.5 kv. One line diagram is shown above.*

LIGHTING

By Leo W. Witz
Continental Electrical Construction Co.
Chicago, Ill.

Table I
URC RESEARCH LUMINAIRE
(4—40 Watt lamps)

FOOT-CANDLES PER WATT PER SQUARE FOOT			
Area to be Illuminated Sq.Ft.	At Mounting Height		
	8'-8½'	9'-9½'	10'-10½'
100	8.19	7.37	6.28
150	8.76	7.56	6.72
200	9.28	8.19	7.37
300	9.83	9.28	8.19
400	10.64	9.83	9.28
600	10.92	10.64	9.83
800	11.46	10.92	10.64
1200	12.18	11.46	11.46
1600	12.83	12.18	12.01
2400	13.02	12.83	12.18
6000	13.24	13.10	12.83
8000 and over	13.65	13.24	13.10

Note: Table derived on basis of using 40-watt, 3500° K white lamps. Wattage allowance per lamp is 50 watts including ballast. Assumed Reflection Factors are: Ceilings—75%; walls—50%. Normal room dimensions were assumed. Maintenance Factor—65%.

THE rapid progress of the electrical construction industry in the past few years has taught the contractor the need and importance of job engineering. Those who were not equipped to offer this service found themselves bypassed for those who had the talent and facilities to start a project from scratch and end up with a well-engineered installation.

Lighting of the commercial and industrial type presents just such a field for active participation of the electrical contractor. In the past many lighting fixture contracts have bypassed the electrical contractor on the job simply because he was unable to make specific recommendations. The owner, then feeling no moral obligation to the contractor, has gone direct to the manufacturer, wholesaler or utility lighting representative for his layout and purchases of fixtures. Contractor associations, realizing this deficiency among their members, have sponsored courses in lighting applications or recommended attendance at prescribed courses being offered. Many contractors, eager to build up their lighting business, have taken advantage of this and are learning to make lighting recommendations as well as installations.

Frequently the contractor is requested to give spot estimates of lighting requirements right on the job. If he has his lighting handbook handy or sufficient manufacturers literature at his command he can, through laborious calculations, give the answer. If not, it means going back to the office, making the necessary calculations, then returning with the recommendations. There is a need for such data to be condensed into working information which the contractor can readily use on the job. Some lighting fixture manufacturers have developed lighting calculators for specific fixtures, but in the main it is up to the contractor to develop his own condensed material.

We, in our organization, have encountered this problem. Our solution was to develop two sets of condensed tables—one for the convention-

Chart 1
DEVELOPING TABLES

Find Foot-candles per watt per square foot for a 4 lamp commercial URC Fluorescent unit mounted 8-8½ ft. from the floor in a room 1200 sq. ft. in (20'x60') area. Lumens per lamp=2100

Data from Lighting Tables:

RI—Room Index = C

CU—Coefficient of Utilization = .446

MF—Maintenance Factor = .65

From Formula:

$$\text{Total Lamp Lumens} = \frac{\text{Foot-candles} \times \text{area}}{MF \times CU}$$

$$\text{Foot-candles} = \frac{\text{Total Lamp Lumens} \times MF \times CU}{\text{Area}}$$

$$\text{FC/Fixture/sq.ft.} = \frac{8400 \times .65 \times .446}{1 \text{ sq.ft.}} = 2435.16$$

Each Fixture consumes 200 watts (160—lamps, 40—ballast)

$$\text{FC/watt/sq.ft.} = \frac{2435.16}{200} = 12.18$$

See value 12.18 in Table I

CALCULATIONS on the JOB

Many contractors are requested to give spot estimates of lighting requirements in the field. This Chicago contractor has done the long involved calculations in the office and developed tables which facilitate quick calculation of lighting requirements on the job.

Chart 2
SOLUTION OF PROBLEM

PROBLEM

Determine the number of 2-lamp RLM Fluorescent fixtures (2-40W lamps) to provide 35 foot-candles of general lighting in an industrial area 84 ft. by 112 ft. Units to be mounted 9 ft.-6 in. above floor.

SOLUTION

CONVENTIONAL METHOD (Total Lamp Lumens)

From Lighting Data Tables:

RI – Room Index = A

CU – Coefficient of Utilization = .74 — 1 – 40 watt, 3500° K fluorescent lamp has 2100 Lumens

MF – Maintenance Factor = 75

$$\text{Total Lamp Lumens} = \frac{\text{Foot-candles desired} \times \text{area}}{\text{CU} \times \text{MF}}$$

$$= \frac{35 \times 84 \times 112}{.74 \times .75} = \frac{392{,}280}{.555} = 593{,}300$$

$$\text{No. Fixtures} = \frac{\text{Total Lamp Lumens}}{\text{Lamp Lumens per fixture}} = \frac{593{,}300}{2 \times 2100} = 141+$$

SHORT METHOD (Foot-candles per Watt per Sq. Ft.)

From Table 2: FC/Watt/Sq.Ft. for 9 to 9½-ft. mounting height in an area exceeding 8000 sq. ft. = 23.3

$$\text{Total Watts/sq.ft.} = \frac{\text{Avg. foot-candles}}{\text{FC/Watt/sq.ft.}} = \frac{35}{23.3} = 1.5$$

$$\text{No. Fixtures} = \frac{\text{Watts/sq.ft.} \times \text{area}}{\text{Watts/fixture}} = \frac{1.5 \times 84 \times 112}{100} = 141+$$

Table 2

RLM INDUSTRIAL FLUORESCENT UNIT

(2 – 40 Watt lamps)

FOOT-CANDLES PER WATT PER SQUARE FOOT				
Area to be Illuminated Sq.Ft.	At Mounting Height			
	7'-7½'	8'-8½'	9'-9½'	10'-11'
100	16.38	15.54	15.12	11.65
150	17.00	15.75	15.33	12.60
200	18.27	17.00	15.75	15.12
300	19.56	18.27	17.01	15.75
400	20.16	18.90	18.24	17.01
600	20.58	19.56	18.90	18.24
800	21.50	21.08	19.44	18.90
1200	22.26	21.71	21.08	21.08
1600	22.89	22.46	21.71	21.36
2400	23.10	22.89	22.68	21.71
6000	23.43	23.10	23.01	22.68
8000 and over	23.52	23.43	23.30	23.01

Note: Table derived on basis of using 40-watt, 3500° K white lamps. Wattage allowance per lamp is 50 watts including ballast. Assumed Reflection Factors are: Ceilings – 75%; walls – 50%. Normal room dimensions were assumed. Maintenance Factor – 75%.

al RLM type two-lamp fluorescent unit for industrial applications; the other for the URC commercial fluorescent unit. We have standardized, in our lighting sales, on these two specific units. Use of these table values (foot-candles per watt per square foot) in two short calculations permits us to make specific recommendations on the job.

Development of Tables

These tables are not a short cut to lighting calculations. They are merely a condensation of basic data in a form that lends itself to simple quick calculations on the job. The values are derived from the basic illumination formula that takes into consideration such design data as room index,

Chart 3
VALUES* USED IN DEVELOPING URC TABLE 1

Area of Room	MOUNTING HEIGHT					
	8'-8½'		9'-9½'		10'-11'	
	Room Index	CU x MF	Room Index	CU x MF	Room Index	CU x MF
100	H	.195	I	.1755	J	.1495
150	H	.209	I	.180	J	.1600
200	G	.221	H	.195	I	.1755
300	F	.234	G	.221	H	.195
400	E	.2535	F	.234	G	.221
600	E	.260	E	.2535	F	.234
800	D	.273	E	.260	E	.2535
1200	C	.290	D	.273	D	.273
1600	B	.3055	C	.290	C	.286
2400	B	.310	B	.3055	C	.290
6000	A	.320	A	.312	B	.3055
8000 and over	A	.325	A	.320	A	.312

NOTES:

Maintenance Factor for URC unit is 65%.

(*) Value in above chart = .65 x Coefficient of Utilization assigned.

(1) See assumption 5 in story for explanation of different CU values for same Room Index.

Same development was made for RLM units using Lighting Handbook values.

lamp lumens, area, coefficient of utilization and maintenance factor:

$$\text{Total Lamp Lumens} = \frac{\text{Foot-candles desired x area in square feet}}{\text{Coefficient of Utilization x Maintenance Factor}}$$

Solution of this formula for "Foot-candles" using lamp lumens for one fixture and a one square foot area will give the "Foot-candles per fixture per square foot." Dividing this result by the total watts per fixture will give the table value "Foot-candles per watt per square foot" for the particular fixture under consideration (see sample development in Chart 1).

Some assumptions necessarily were made in developing the tables. These include:

1. The use of 40-watt, white, 3500° Kelvin fluorescent lamps with a rating of 2100 lumens per lamp.

2. Total wattage per fixture includes wattage consumed by ballasts. (A two-lamp fixture would be 100 watts—80 watts for the two lamps and 20 watts for the ballast.)

3. Arbitrary values of reflection factors were 75 percent for ceilings and 50 percent for walls. (Used with room index in determining coefficient of utilization in above formula.)

4. The square foot area contemplated normal room dimensions. (For example: a 1200 sq. ft. area would be a room 20 ft. by 60 ft.—not a room 10 ft. by 120 ft.)

5. Some liberties were taken in assigning handbook values of coefficient of utilization, particularly where the same room index is indicated for various mounting heights. The coefficients were varied slightly to compensate for the mounting height differential.

Each table value was worked out as a separate problem, using the handbook or manufacturers design data. All the heavy calculations were made beforehand leaving the table values for rapid calculations on the job.

The first step in applying the tables is to determine the area in square feet to be evenly illuminated at the desired foot-candle intensity. Then, knowing the type of fixture to be used (RLM type for industrials and URC for commercials) refer to the proper table (Table 1—URC; Table 2—RLM). Opposite the area involved find the "foot-candles per watt per sq. ft." under the mounting height to be employed.

The watts per square foot is determined from the following furmula:

$$\text{Watts/sq. ft.} = \frac{\text{Average foot-candles desired}}{\text{FC/watts/square foot (the table value)}}$$

Then:

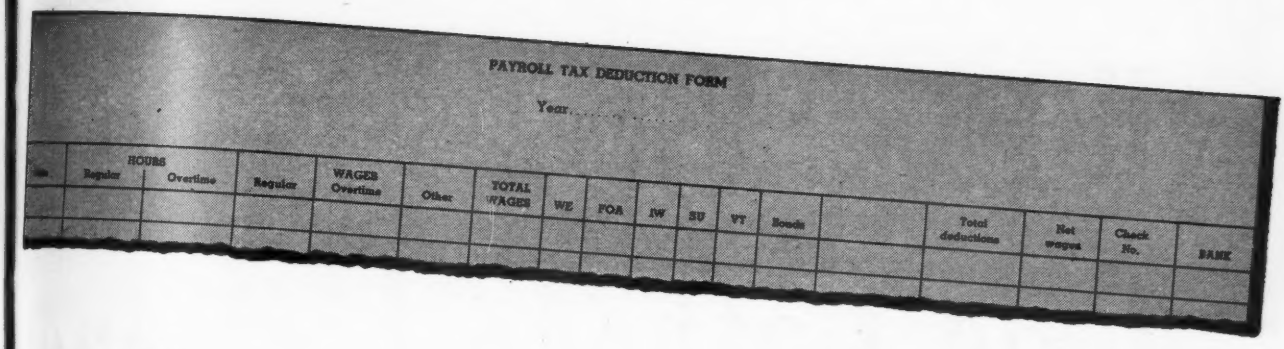
Total watts—watts/sq. ft. x area of room

Knowing the total watts and the watts consumed per fixture, determine the number of fixtures required as follows:

$$\text{Number of fixtures} = \frac{\text{Total watts required}}{\text{Watts/fixture}}$$

The simplest way to follow this through is to refer to the "Short Method" solution of a problem outlined in Chart 2. Here the same problem is solved by both methods—using the Foot-candles/watt/sq. ft. formula and the Total Lamp Lumens formula.

At first examination the condensed method may seem as involved as the conventional method. However, after it is used a short time the simplicity of the calculations becomes evident. Our sales engineers have been taught this method and continually carry the two tables with them to make quick job requirement lighting recommendations. Frequent checking of layouts by using the long method has revealed identical answers (within one or two fixtures—which after all is usually controlled by architectural features of the area to be lighted.)



PAYROLL TAX DEDUCTION FORM

Year.....

	HOURS		WAGES														
	Regular	Overtime	Regular	Overtime	Other	TOTAL WAGES	WE	FOA	IW	SU	VT	Bonds		Total deductions	Net wages	Check No.	BANK

Your TAX RECORD

By Arthur Roberts

A system to facilitate tax deduction recordings by electrical contractors, which will save expense and minimize penalties.

THE government insists upon accurate payroll recording so the electrical contractor must detail the different withholding clearly. To effect efficient recordings, use a payroll form combining all essentials on one sheet, total wages paid, hours worked to show compliance with wage and hour law, income withholdings, Victory Tax, social security, state unemployment, if your state so decrees, bond deductions, etc. A combined payroll register simplifies filing of returns, reports to employees and audits.

If you discharge an employee or he leaves, can you give him a statement of earnings and deductions as required by law? Can you give each employee a statement of total earnings and deductions by January 31, the month following the 4th quarter, on Form W-2? Can you make up quarterly returns on Form W-1 quickly? Can you fill out a detailed return after the fourth quarter reconciling quarterly returns with the wages paid individual employees on Form W-3 in a short time? Or will it take you hours to dig up this information from your books, with no assurance that it is correct, increasing payroll expense and hazardous penalties? You can keep out of difficulty if you use a payroll withholding form similar to the one shown here.

Enter the payroll date, hours worked, wages, overtime, withholding exemption (WE), Federal Old Age Benefit (FOA), income withholding (IW), Victory Tax (VT), state unemployment tax (SU). The blank columns are for listing other deductions. Under "Bank", enter the deposit of tax monies and make this deposit as soon as possible after deduction. Open a special account for these deposits or use your regular account, in which case, make a separate deposit of the money to the PENNY so that you can identify it as against your business income and check it easily against payroll listings.

If withholdings are more than $100 monthly, deposit the money in an authorized depository before the 10th of the following month. Mail depository receipts to the Collector in lieu of cash every quarter accompanied by Form W-1. List only the total tax deducted for the quarter, individual listings are not necessary. Quarterly returns are due before the last day of the following month. At the end of each year, make a reconcilement on Form W-3 of quarterly returns (Form W-1) with copies of Form W-2 given employees covering income tax withheld on wages. Also send along a list, an adding machine tape or other convenient form, setting forth the items of tax withheld as shown on the Forms W-2. Victory Tax and income withholdings are now reported on the same forms. If your withholdings are less than $100 during the month, make returns quarterly to the Collector. You need not deposit the money monthly.

Social security withholdings must be declared quarterly, the same as income tax withholdings. Use Form SS 1-A. This Act imposes an employers' tax of 1 per cent on wages paid by each employer and an employees' tax of 1 per cent on wages received by each employee. If you have eight or more employees on a total of 20 or more days during the calendar year, each such day in a different calendar week, you must file an annual return under the Federal Unemployment Tax Act on form 940 before January 31 of the following year, the same as the final return on withholdings. Amounts in excess of the first $3,000 paid for services are excluded.

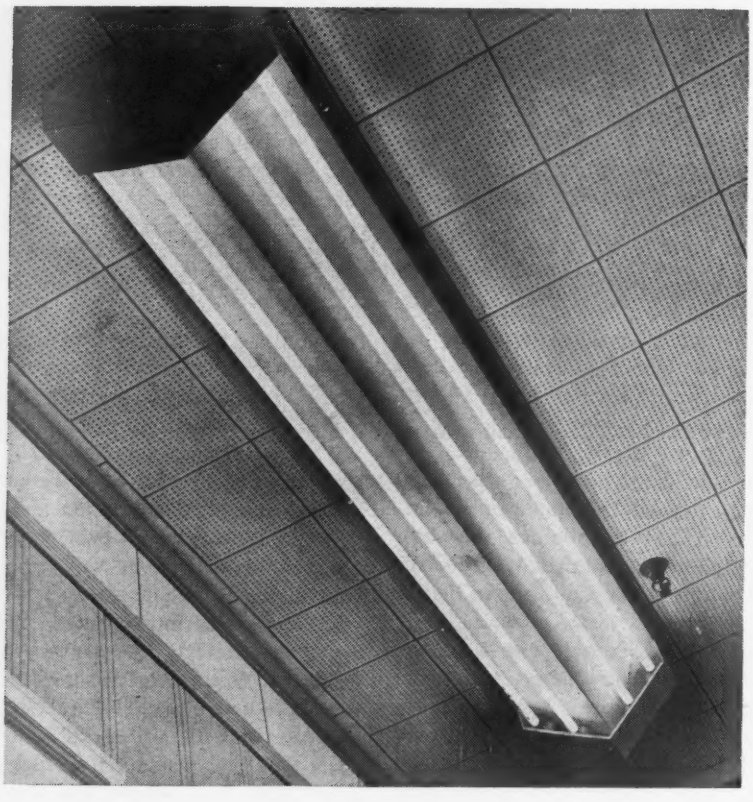
The Social Security Act established a cooperative Federal-State system for unemployment compensation and each state administers its own law. In some states, employee and employer contribute, in other states, only the employer. In most states, returns are filed quarterly, the same as withholdings. Remember that even though you have fewer than eight employees and need not file a Federal return on form 940, you may have to file under your State law, where this law may apply if you have only one person in your employ.

You may purchase a columnar sheet with sufficient columns to write in the headings as shown on the specimen

[Continued on page 127]

Higgins Uses Cold-Cathode Lighting

Continuity of operation and reduced maintenance influenced the choice of cold-cathode fluorescent illumination for new drafting room at Higgins Shipyard in New Orleans.

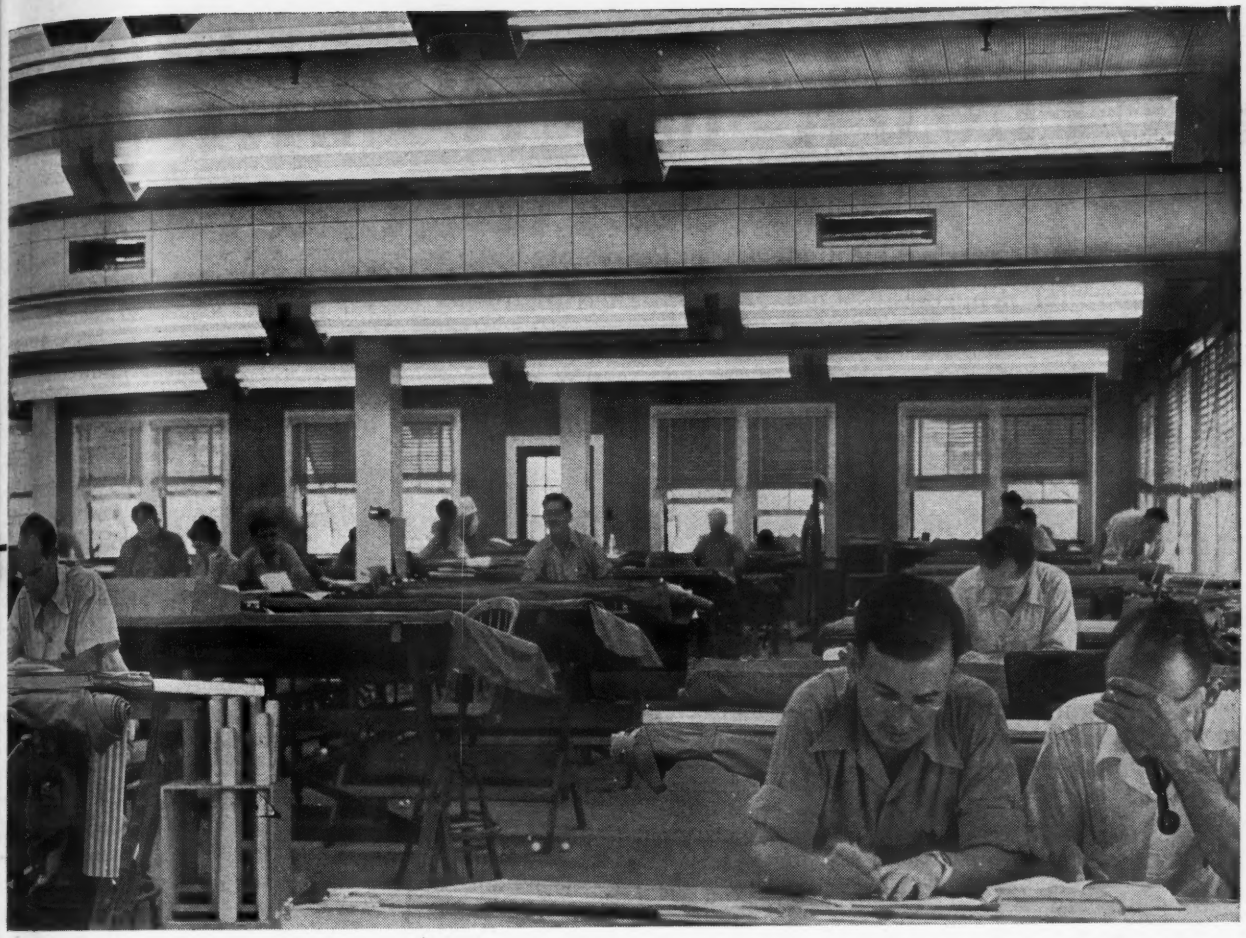


A TYPICAL UNIT, of the type that made up the continuous rows, contains four, 8-ft. tubes. Metal shields cover the socket connections.

PLANS for hundreds of combat and cargo vessels are drawn up under a canopy of high intensity cold-cathode fluorescent lighting in the engineering department of Higgins Industries Industrial Canal Plant at New Orleans. The choice of this type of light source for their new drafting room was based on careful study and experiment with several types of lighting by Milton L. Levy, electrical engineer for the Higgins concern.

About six months before the new 50,000 sq. ft. drafting room was built, Mr. Levy had several sample, 8-ft., four-tube, cold-cathode units installed in an office. One unit was operated around the clock for test purposes. The fact that this unit operated for this period without requiring lamp replacement or service indicated it was a lighting system with a minimum of maintenance—an important adjunct to efficient shipyard operation.

Industrial Electric, Inc., New Orleans electrical contractors and sign manufacturers, provided and installed the system consisting of 250 fixtures, each containing four, 8-ft., 25 mm. tubes (about the diameter of a 30-watt conventional fluorescent tube). The units are ceiling mounted end-to-end in continuous rows of 7½-ft. centers. Mounting height is 11 feet. The tubes



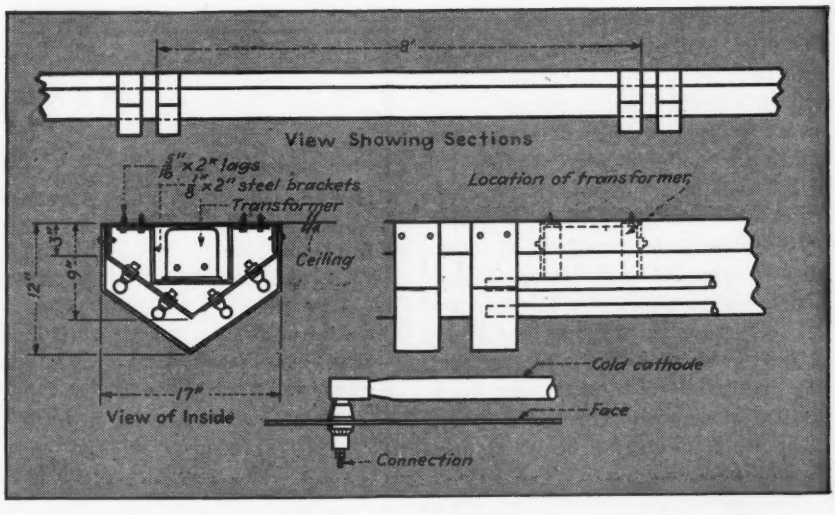
***A NEW LIGHT** source is proving itself in the drafting rooms of Higgins Industries, Inc., New Orleans shipbuilders. Cold-cathode fluorescent fixtures, totaling 8,000 feet of 25 mm. tubing and mounted in continuous rows, provide 65 foot-candles of cool, shadowless and glare-free illumination on the boards.*

are unshielded on V-shaped reflectors with end shields enveloping the tube connections.

Compact, streamlined, 230/12,000-volt, 120 milliampere transformers, with opposite-end low and high voltage connections, are bracket mounted in the reflector recess, making them integral parts of the fixture. Through-connections between units provide continuous raceways for fixture and circuit wiring, reducing the number of ceiling outlets to a minimum. Removal of the fixture end shields facilitates replacement of the tubes which are equipped with removable sockets.

Branch circuit design and control is simple. Each transformer comprises a circuit, feeding three 8-ft. fixtures or a total of twelve 8-ft. tubes. The fixtures are so mounted that two such transformers are fed from a single ceiling outlet with the primaries connected on alternate phases of the 230-volt, three-phase circuit wires to minimize stroboscopic effect. The 12,000-volt secondaries then feed the tubes in the fixtures. Each single-phase branch circuit is controlled at the panel by a two pole toggle switch with a cartridge fuse in each phase leg. Thus the lights are operated in 24-ft. sections—three 8-ft. fixtures per transformer and one transformer per panel switch.

Initial lighting intensities averaged better than 75 ft.-candles on the working plane. After 200 hours of operation, the intensity dropped to 65 foot-candles and only a slight additional reduction in the light output is expected. When the engineering personnel took over the new area, they immediately discarded individual portable desk lamps they had been using—a feature that more than pleased the draftsmen.



***BUILT-IN TRANSFORMERS** are an integral part of the fixture housing. Mounting details are shown in this portion of the shop drawings outlining the fixture and continuous row construction.*

OUTLOOK for APPLIANCES

Wiring and electrical appliances are inexorably linked in parallel progress. What are appliance manufacturers and dealers planning for postwar? This article selects some of the highlights of a broad study prepared by the editors of *Electrical Merchandising*.

WIRING grows with appliance progress, and appliances develop with wiring adequacy. The interdependence of wiring and appliances is complementary, an essential element of planning that isn't always obvious. But whether or not the contractor is engaged in appliance merchandising, his wiring jobs are directly affected by the statistics of range and water heater sales, the market opportunities for ironers and washing machines or the television manufacturer's promotion campaign.

This year the leading magazine of electrical appliances, *Electrical Merchandising*, has analyzed postwar market potentials for appliances and we have abstracted a small part of this broad study to bring out the highlights of the outlook in this industry branch.

Here is the national picture. Nearly 100 utilities, serving 13,578,012 residential customers, close to one half the wired homes in the country, answered a questionnaire and reported the following significant facts:

Roughly two-thirds—63 percent—of the utilities are planning to merchandise. An additional 7 percent are still undecided, and 30 percent have definitely decided not to engage in any direct selling. Over half of those utilities planning to merchandise, will sell a complete line of major appliances; the remainder will confine themselves largely to load-building items such as ranges and water heaters. Chief reason given for this renewed interest in appliance selling is the need of the power company to replace present industrial and other war loads. Most of the companies reporting, however, are planning full dealer co-operative programs.

The survey also reveals that out of a total of 24,069 dealers of all types who were selling appliances in 1941, 16,802, or 70 percent, are still in business, and the greater number of these are expected to remain in business for the duration. New dealers of all types are expected to enter the field, however, and here the feeling seems to be that the chain type of operation, especially in the tire and automotive accessory fields, will be increasingly important factors in the postwar merchandising picture.

In the United States as of January 1, 1944 there were 28,000,000 wired homes. The table shows this figure broken down geographically and under the headings urban, rural-non-farm and rural farm. These classifications call for some explanation. Urban includes cities or other incorporated places having 2500 inhabitants or more. Rural-non-farm dwelling units are those located outside the boundaries of urban places but not on farms. This group is composed of dwelling units in a wide variety of locations, ranging from isolated non-farm homes in the open country to homes in small unincorporated areas adjacent to a large city. Rural farm dwelling units are those located on farms outside urban places.

The report estimates that there is a need for at least 4,100,000 new electrical refrigerators. Postwar market for five years beginning 194X should call for a minimum of 3,750,000 electrical refrigerators annually. Approximately 775,000 new electric ranges are needed and a postwar market of 785,000 annually.

On other appliances, estimates show a need for at least 2,500,000 new electric and 210,000 new gas engine washers. There is also an immediate market for at least 140,000 ironers. Postwar market should be a minimum of 2,300,000 electric washers and 270,000 ironers annually. Also heating appliances, cleaners and dishwashers will find ready markets.

There are 6,000,000 American farm families in the United States but at the present time there are only 2,566,230 farms connected to power lines. Judging from the pre-war rate of additions, accelerated through the efforts of the REA, it is reasonable to

WIRED HOMES

SECTION	TOTAL Jan. 1, 1944	URBAN	RURAL NON-FARM	RURAL FARM
New England	2,236,000	1,690,765	442,586	102,649
Middle Atlantic	6,872,000	5,405,344	1,148,700	317,956
East North Central	6,665,000	4,754,270	1,216,052	694,678
West North Central	2,585,700	1,585,013	654,246	346,441
South Atlantic	2,763,100	1,625,030	821,140	316,930
East South Central	1,253,500	739,517	344,355	169,628
West South Central	1,818,600	1,199,880	423,943	194,777
Mountain	815,900	440,563	250,105	125,232
Pacific	2,990,200	2,070,376	621,885	297,939
	28,000,000	19,510,758	5,923,012	2,566,230
	100%	69.68%	21.15%	9.17%

Prepared by *Electrical Merchandising*

INDEX OF SATURATION—JANUARY 1944

All figures, except radio, based on 28,000,000 wired homes and farms. Radio based on 36,544,000 homes.

Appliance	Percentage of Homes With	Number of Homes With	Percentage of Homes Without	Number of Homes Without
REFRIGERATORS	70.9	19,864,000	29.1	8,136,000
RANGES	12.7	3,567,000	87.3	24,433,000
WATER HEATERS, STORAGE	3.9	1,084,000	96.1	26,916,000
HEATERS & RADIATORS	19.7	5,523,000	80.3	22,477,000
WASHERS (ELECTRIC)	61.9	17,338,000	38.1	10,662,000
IRONERS	6.9	1,938,000	93.1	26,062,000
IRONS	92.7	25,965,000	7.3	2,035,000
TOASTERS	58.6	16,409,000	41.4	11,591,000
CLEANERS (FLOOR)	49.0	13,707,000	51.0	14,293,000
CLEANERS (HAND)	11.0	3,072,000	89.0	24,928,000
PERCOLATORS	37.0	10,350,000	73.0	17,650,000
CLOCKS	62.5	17,510,000	37.5	10,490,000
WAFFLE IRONS	23.3	6,524,000	76.7	21,476,000
HEATING PADS	22.8	6,386,000	77.2	21,614,000
HOT PLATES	17.2	4,816,000	82.8	23,184,000
ROASTERS	5.7	1,606,000	94.3	26,394,000
RADIO RECEIVERS	83.5	30,500,000	16.5	6,044,000

Prepared by *Electrical Merchandising*

assume that between 200,000 and 300,000 new farms will be added to the lines each year following the peace.

Primary job for the industry, where new farm customers are concerned is to sell the need for an adequate wiring system, with the distribution center located to insure service being carried economically and efficiently to all farm buildings. Adequate copper, both in feeder and branch circuits must be of sufficient size to take care of future loads without overhauling the system.

There are over 200 well-known uses for electricity on the farm and many new uses such as frozen food storage, sharp freezing, dehydration, arc welding, television, etc. are in process of development. Electric milking machines, milk coolers, brooders, incubators and the like are already accepted and used by the modern farmer, while the portable motor, with its many applications, has come to take the place of many a hired man.

These 6,000,000 farm families will want all the home appliances for comfort and convenience—and will get them—but their first concern is going to be to own the equipment that is important from a productive angle. Manufacturers are laying plans now to sell them, too. Water system manufacturers, for instance, have figured they can produce and sell 500,000 water systems the first year after the war and the largest year's volume previously was 347,000 units in 1941. At present, they are producing at about 67 percent of 1941 sales—all sold to farms—and that is about the normal percentage sold to farms.

Look at the present saturation of appliances in farm and rural non-farm homes. Of the 2,566,230 farms at present connected to power lines, 1,384,497, or 53.95 percent, own electric refrigerators; 352,051, or 13.72 percent own electric ranges. Of the 5,923,012 rural non-farm homes, 3,619,379 or 61.11 percent, own refrigerators; 1,226,073, or 20.70 percent, own electric ranges. Once electricity is installed, the rural and small-town home-owner will want the latest in labor-saving and time-saving devices. But even this market is still far behind the urban market in ownership—a situation which may not obtain for very long in the postwar years when the farmer's purchasing power begins to make itself felt and the industry does a selling job.

EDITORIALS

W. T. Stuart, *Editor*

Out With No. 14 Wire

With postwar building plans still in preliminary form, with manufacturers of wire and wiring materials facing reconversion planning and with warehouse stocks of wire at a low ebb, the time is ripe for eliminating, once and for all, the No. 14 wire standard that has done so much to strangle wiring and appliance progress.

For years now, specification grade commercial, industrial and institutional wiring has used a No. 12 minimum, often with No. 10 home runs. A concerted industry effort from now on could establish No. 12 as the commercial minimum for all conventional wiring jobs, relegating No. 14 to an odd size category for special circumstances.

Should the move be supported by a revision of the Code? Maybe, but it is not essential. The code recognizes many odd wire sizes that are practically unknown in wiring practice, No. 5 and No. 3 for example. Manufacturing standards and efforts toward simplification have cut down the use of many other sizes. The same technique applied to No. 14 would quickly reduce it to a subordinate role among the branch circuit conductor sizes.

Efforts in the past to establish a No. 12 standard have run up against bulging warehouse stocks, established manufacturing schedules and plain inertia. Today we have stringent material economy to bar its adoption in war construction. But for postwar the road is wide open. And now is the time to get it rolling.

Drop Limitations

Limitation Order L-225 which sets up rules limiting the manufacture and use of conduit is no longer essential and ought to be dropped. Other controls are active at the manufacturing level and L-41, limiting construction, is effective at the point of use. Consequently specific rules pertaining to where and how conduit and EMT may be used simply introduce difficulties in executing the jobs permitted under L-41.

While L-225 allowed conduit to be used wherever it was specifically required by the National Electrical Code, the minimum code provisions were not written to take care of such a situation. There have been, consequently, plenty of headaches for inspectors and installers to square the intent of the order with the limitations of the Code as an engineering and installation guide.

The present supply of metals, available warehouse stocks and surplus materials all indicate that no critical material situation stands in the way. Let's hope that L-225 can be written out of the rules as quickly as possible.

Light Needs Control

A study of commercial prospects for fluorescent lighting conducted recently in Pittsburgh shows a high percentage of the potential customers thinking in terms of exposed lamp fixtures. Some recent cold-cathode promotion uses such expressions as "no costly light-reducing screens or shades required. White ceiling the sole reflector required." These portents carry a warning. Are we moving so fast in lighting design and materials that we are leaving the public—and a good share of our own industry—way behind?

Fluorescent lighting, little more than five years old, opened vast new horizons in lighting application. High illumination levels of high quality lighting came within the scope of commercial practice. Linear sources of comparatively low brightness stimulated ingenious luminaire design. And the whole industry has contributed to revolutionary changes in layout and use. But the elementary principles of good illumination still hold true. Raw lumens, foot-candles on the light meter, are not the ultimate measure of good lighting and never were. By the same token bare lamp jobs, however attractive the pattern, rarely qualify as good illumination.

If leaders in illuminating engineering have already rejected the bare lamp job as obsolete while it still stands out as a major consideration in the market place, we need better liaison. IES chapters around the country are in a strong position to help. But more contractors ought to be active in their affairs. The RLM and Fleur-o-lier groups of manufacturers are another strong influence. They should have vigorous and generous support because the accelerated progress of lighting development multiplies the problem again and again.

And how quickly we can line up industry practices with the conservative body of certain and experienced knowledge at our disposal will depend on how quickly we recognize and act when the symptoms of poor liaison start to appear.

Lumber Becomes Critical

Now that we are thoroughly geared to substituting wood for critical metals in all kinds of construction items, supports, hangers, barriers, even substation structures, the lumber situation turns even more critical. Lumber is scarce and will continue to be scarce right up to the last day of the war.

The story of wood in war is a saga of high adventure and headaches for those who must keep our forces supplied. Battles won relieve the pressure for other materials yet multiply the demands for wood. The destruction of modern battle methods is enormous and the first needs of occupying forces is tremendous quantities of lumber for restoration of facilities and shelter.

For electrical men, lumber shortage means a return to conventional metal shapes for supports and hangers, fortunately at a time when the metal situation is easing off from its previous highly critical condition. Lumber should be carefully conserved.

Washington Notes

▶Invasion of the continent imminent and the major element in determining the course ahead for the home front, has given way in Capitol gossip to the significance of naval successes in the South Pacific. The trend of speculation is toward a longer aerial hammering of Germany and a much accelerated movement upon Japan. Political observers look for a dramatic move soon by FDR naming an outstanding industrial figure as his running mate. Bernard Baruch's master postwar plan will help to give business men some idea of what can be expected to happen to government controls as the end of the war nears.

▶Disposal of surplus materials, which has been looked upon as a major threat to postwar market stability, may be considerably less of a bugaboo than some economists have predicted. Surplus stock piles will be huge, but not especially in the categories that affect civilian economy.

▶Manpower problems are still acute, however, the emphasis is on the conservation and reallocation of present supplies of munitions workers. Up to July the armed forces will be taking about 250,000 a month through selective service and each month they will reach into higher levels of skill and experience, men difficult to replace in industry. One bad headache for manpower administrators is the tendency for essential men to seek out jobs with a postwar future. The total civilian labor force will be 54.4 millions in July, WMC predicts.

▶One of the important deterrents to some small construction revival, with the growing availability of certain building materials, is continued critical shortage in certain components and manpower. A building planned in a non-critical labor area would draw parts and gadgets from seriously short manufacturing communities.

▶Total volume of construction activity in November (reported January 27) was $401,298,000 or 13 percent under October, according to WPB. December figures, it is estimated, are 11 percent less than November. The four major classifications amount to 1) military, $132,984,000; 2) industrial, $96,514,000; 3) housing, $101,800,000; 4) all others, $70,000,000.

▶Ship construction totalled 19,239,000 deadweight tons in 1943 and the schedules will hold up through July of this year. More electrical contractors are turning their attention to marine construction as war building prospects fall off.

▶About 100,000 fans are scheduled this year for military and essential needs.

"OR EQUAL"

Last month our lead editorial "Or Equal or Worse" condemned the current action of leading architects toward naming only one manufacturer's product in specifications and eliminating the "or equal" clause. We recommended, instead, clear and accurate specifications, competent job inspection and the letting of mechanical contracts direct to qualified and reputable bidders.

A few of the many pertinent comments for and against from contractors, manufacturers, architects and others follow:

To the Editor—"I agree that you are touching a very pertinent spot in the construction industry and that the customer would benefit ahead of all others if the practices you advocate could be carried out."

J. N. Pierce
Chicago, Illinois

To the Editor—"I personally very definitely agree with your viewpoint and opinion.

"I sincerely hope that you will use the opportunities at your disposal to combat the efforts of those in the American Institute of Architects who believe the solution to the 'or equal' clause is merely its elimination from the specifications."

M. J. Whitfield,
Appleton Electric Co.
Chicago, Illinois

To the Editor—"The conditions as you have stated them are factual and your suggestions are sound and practical.

"Your thinking is strictly in accordance with the policy of this Association and, therefore, we unhesitantly endorse the same."

Robert W. McChesney, Pres.
National Electrical Contractors Ass'n.
Washington, D. C.

To the Editor—"I believe when you have the complete history of the study which has been carried on for a number of years by the Producers' Council, Inc., and the American Institute of Architects, you will join us in the belief that the elimination of the 'or equal' clause can be made a step in the right direction."

Russell G. Creviston
Crane Company
Chicago, Illinois

To the Editor—"The looseness with which so many specifications are written, misinterpreted and disregarded by the architects in passing the finished job is largely responsible for the type of competition which too frequently prevails today. Certainly this cannot be improved by eliminating two words in the specifications which at least implied that standards must be maintained in the performance of the job.

"I compliment you upon your presentation of this problem and for laying in the lap of the architect at least his share of the responsibility."

Laurence W. Davis, Gen. Mgr.
National Electrical Contractors Ass'n.
Washington, D. C.

To the Editor—"It seems to me that direct letting of contracts, reliance on reputable contractors, and a more thorough knowledge by the architect of the problems and materials involved would lead to better construction and efficiency. Your editorial therefore points to an improvement in doing things that I hope will bear fruit."

Richard S. Hayes
The Okonite Company
Passaic, N. J.

To the Editor—"I certainly agree the elimination of the 'or equal' clause will not solve the problem of obtaining quality materials and it would be desirable to leave this clause as it now reads until the architects can establish a better procedure."

J. K. Murphy
Dahlstron Metallic Door Co.
Jamestown, N. Y.

To the Editor—"We hope that your editorial will have the proper restraining effect in any AIA meeting discussions and that these groups will recognize that the problems that are involved cannot be solved with words."

A. R. Johnson
Cutler-Hammer, Inc.
Milwaukee, Wisconsin

To the Editor—"I agree that some architects write sloppy specifications and do not furnish adequate supervision to be sure that they obtain type and quality of materials which the specification might intend.

"I do not agree that this is universal nor can I agree that it would be overcome by hiring electrical engineers or job inspectors, as I found in both cases this does not solve the problem.

"The most satisfactory method is to select three articles of equal merit, specify them outright and permit no substitutions outside of the articles specified. I believe that this gives adequate leeway in competition and it certainly assures the owner getting the material which he is paying for.

"I do not think you can throw the entire burden for these difficulties on the architectural profession nor do I agree with you that most electrical contractors are over ethical in the materials they put into a job. I have found that they are just as ready to make 'or equal' substitutions whether called for or not. In fact I have at times experienced considerable difficulties in preventing contractors trying to make substitutions and going over our heads to the owners for approval.

"My own opinion on the whole subject is that 'or equal' is a dangerous clause and if possible should be eliminated, but I do not believe that it will be possible to get away from substitutions by specifying only one manufacturer's product."

Douglas Orr, Architect
New Haven, Conn.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

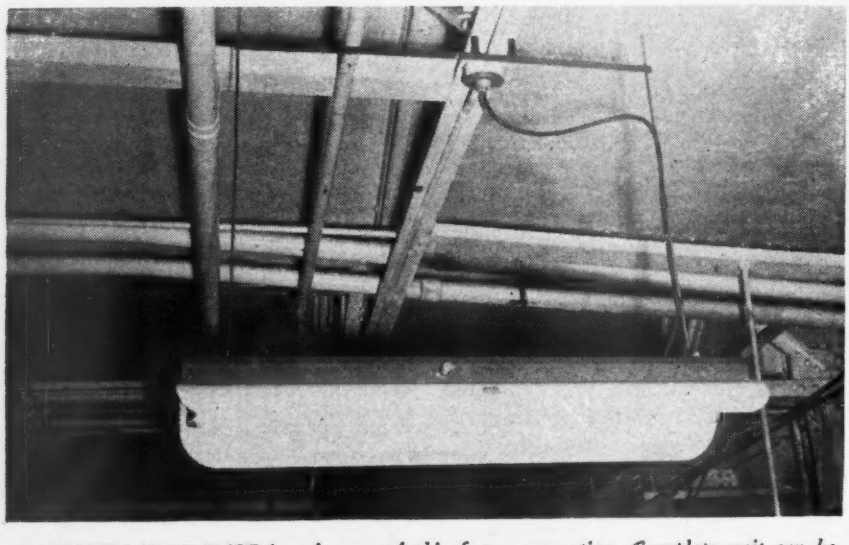
QUICK-CHANGE FIXTURE MOUNTING

WIRING

Fluorescent fixtures in the plant area of the Tool Steel Gear and Pinion Company, Cincinnati, Ohio, are mounted so they can be changed or replaced quickly. This conforms with the maintenance policy of replacing a burned out unit with a spare fixture, then repairing the damaged unit in the maintenance shop. The net result is a substantial reduction in lost-light hours and the speed up in repairs affected by working at bench level instead of 12 or 14 feet in the air.

The typical mounting scheme illustrated in the attendant photograph consists of a length of $\frac{3}{4}$-in. by $\frac{3}{4}$-in. by $\frac{1}{8}$-in. angle iron bolted to the under side of the roof trusses. In this particular case short conduit spacers were used to clear the lighting branch circuit conduit fastened to the underside of the truss. The fixtures are suspended from this angle iron cross arm by two $\frac{1}{4}$-in. bolt rods, threaded at the top and flattened at the bottom to accommodate mounting holes for the fixture. Two horizontal bolts secure the unit to the supporting rods. Long threads on the top ends of the bolt rod permit accurate leveling of the unit when installed.

Electrical connection to the unit is made by a drop cord with a twist type plug that fits into a receptacle in the lighting circuit. A twist of the wrist to disengage the plug and the removal of the two fixture bolts comprises the labor necessary to replace a unit.

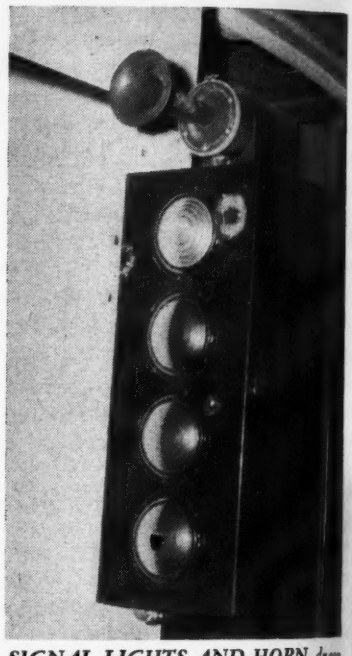


MAINTENANCE EASE is a feature of this fixture mounting. Complete unit can be removed simply by untwisting the electrical plug and removing two bolts securing the fixture canopy to the rod supports.

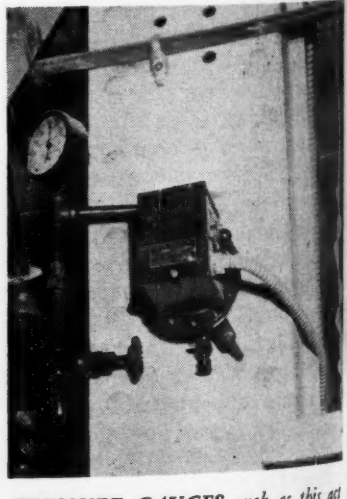
SIGNAL SYSTEMS

INDUSTRIAL

A protective visual-audio signal system is inexpensive and good insurance and can generally be installed at a fraction of a percent of the investment in the equipment and material being protected. The Norton Company of Worcester, Mass., has installed such protection on a number of their kilns. In the manufacture of abrasive wheels, each wheel is passed through a series of kilns for baking and processing. Each kiln is supplied with four services: steam, water, fuel oil and air. If anything should happen to these four services, wheels in process might be ruined; or in the case of air (exhaust fan) failure, a dangerous accumulation of explosive gases might develop.



***SIGNAL LIGHTS AND HORN** draw the attention in case of trouble. The four lights indicate which of the four services, air, steam, water or fuel oil has failed.*



***PRESSURE GAUGES** such as this act as silent sentinels. Should the line pressure of the fluid fluctuate beyond preset limits, the signal system is energized.*

"When, in the course of human events..."

At a time when war disrupts normal distribution and revolutionizes production, it is prudent for manufacturers and wholesalers in our field to formulate plans for postwar marketing activities.

Sylvania has done this and reaffirms its intention to look first to independent wholesalers for the best means of distributing new or improved postwar products for industry, commerce, and home.

This declaration is made with full confidence —

That free competition is the life of trade . . . and progress;

That only independent means of distribution preserves freedom of competition;

That there will always be a place at the top for independents who work together to provide an even higher standard of American living.

It Pays to Sell SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.

EXECUTIVE OFFICES: 500 FIFTH AVENUE, NEW YORK 18, N. Y.

FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, INCANDESCENT LAMPS, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES

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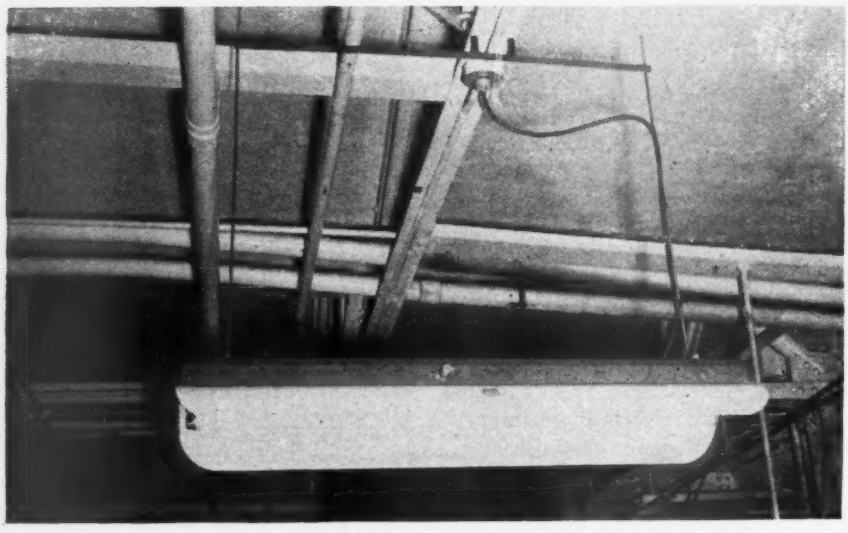

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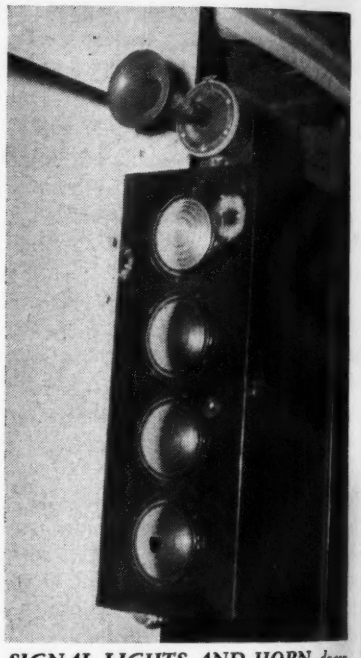

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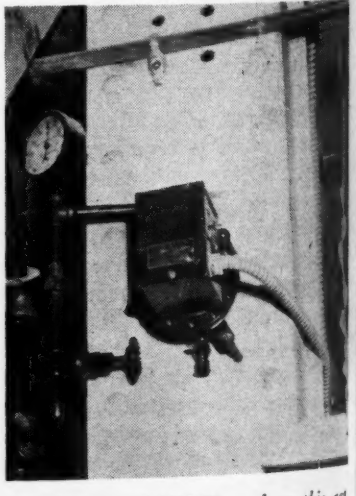

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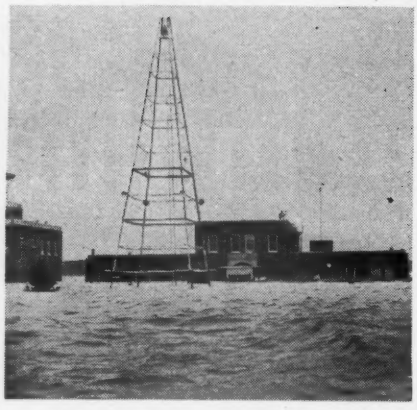
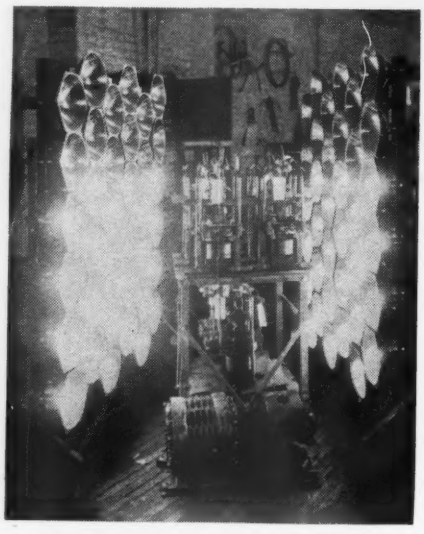
Consequently, to obviate any such occurrence, a visual-audio signal system has been installed. Pressure switches are installed on the water, steam and oil lines and a relay in the exhaust fan circuit. Should the pressure vary above or below the normal preset limits, or should the power supply to the fans fail, the signal system would operate.

A bank of four lights, all of a different color to indicate the failing service, is placed above the kiln. A horn or bell is connected into the signal light circuit so that the operator's attention may be assured. In addition, a relay is connected into the electric power circuit supplying the exhaust fans, so that a power failure will not only energize the signal system, but will also operate a solenoid valve on the oil lines, closing it and stopping the flow of fuel.

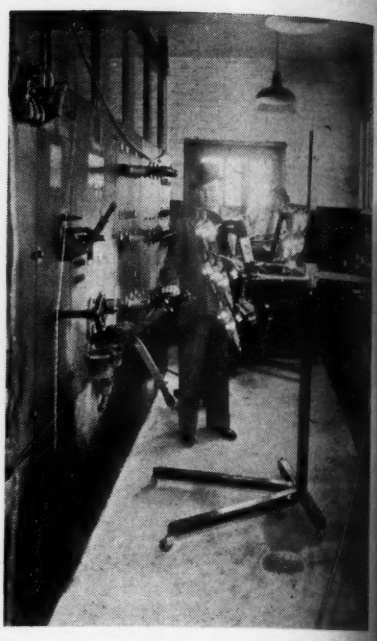
The signal system is energized and controlled by current from an eight volt battery in conjunction with a rectox unit, so that it is not dependent upon an external supply (except for battery charging) in case of emergency.



***SWITCHBOARD CONTROL** building at Omaha Municipal Airport under six feet of water.*



***FLAT BANKS** of near infra-red equipment was utilized by Omaha Electrical Works to dry out a variety of electrical equipment and motors.*



***JOHN M. GIBB**, City Electrician, is seen at the Omaha Municipal Airport where a portable near infra-red unit was used to speedily dry out the large switchboard.*

RADIANT DRYING SPEEDS FLOOD RECOVERY

INDUSTRIAL

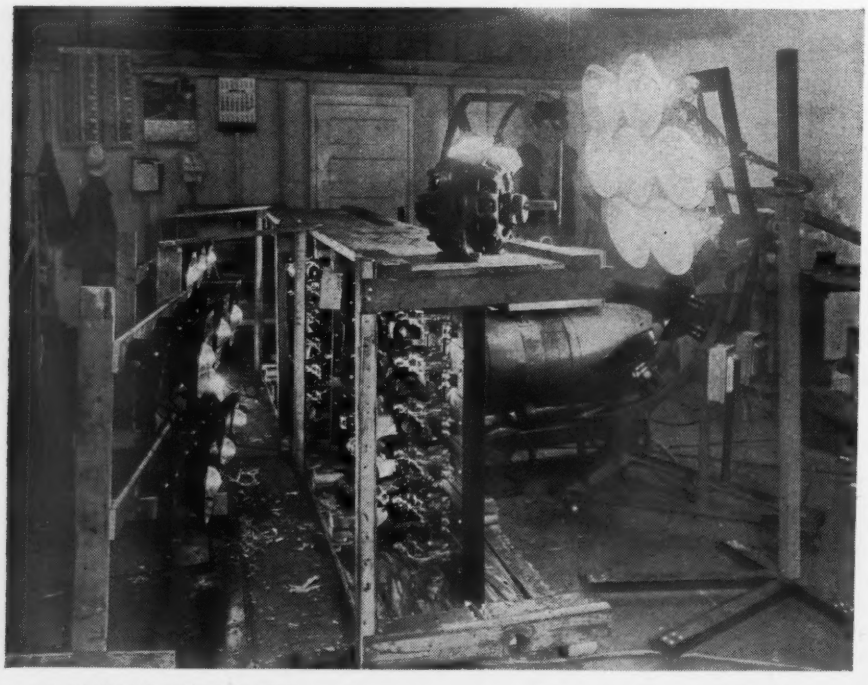
When the Missouri river overflowed its banks this year, industrial plants in Omaha and Council Bluffs, Iowa were seriously hit. After the water subsided, electrical equipment and other machinery was put back in service in double-quick time with the aid of near infra-red equipment, used to dry out the moisture.

Prior to the flood, intensive work was performed by the U. S. Army Corps of Engineers and volunteer help to build up protective dykes and to move some of the critical war industries to new locations. Finally the flood waters crashed through the temporary dykes and flooded four square miles of residential district and scores of industrial plants. At its crest, the water rose to a height of six feet at the Municipal Airport, putting the large switchboard, meters, relays, transformers, controllers and other electrical equipment out of service.

As the water receded, it was apparent that thousands of dollars worth of machinery, motors and other electrical equipment, would be temporarily inoperative. The problem was to dry it out as quickly as possible and restore to service. Motor service shops and electrical contractors were beseiged with calls and the leading shops went on a 24-hour a day schedule.

The Fostoria Industrial Service Center at Omaha was instrumental in getting quick delivery on portable near infra-red equipment which was utilized by the various contractors and motor repair shops for the dry-out jobs in their shop and in the field.

Ordinarily, near infra-red equipment is associated with drying out motors, stators, etc. but in this emergency it was effectively used on blueprint machines, crane control panels, transformers, generators, welding machines, switchboards and heavy machinery. Drying out was accomplished three to five times faster with near infra-red equipment than by any other method.



***RADIANT INFRA-RED** equipment was pressed into service at Schneider Electrical Works, Omaha. Portable models were utilized in any way possible.*

PORCELAIN
PROTECTED WIRING SYSTEMS

Contribute
WIRING EFFICIENCY WHILE AIDING OUR VICTORY DRIVE

★

Quick installations are accomplished—economical results are realized—complete insulation and protection from the entrance switch to the very last outlet on the system — short-proof and shock-proof qualities of porcelain contribute to dependability—rust and corrosion resistance characteristics make porcelain the ideal material in damp, wet, or dry locations—porcelain gives you permanency.

Porcelain wiring, used more extensively than ever before, does a two-fold job. It enables contractors to do industrial, commercial, and residential wiring quickly, adequately, and economically—to provide for America's wiring needs and maintain the highest wiring standards not only for today but for years and years ahead.

Second, Porcelain releases critical materials such as steel, copper and rubber for fighting equipment and has become an important factor in this regard.

Porcelain Protected Wiring Systems have had long recognition for safety, for modern results, for adequacy, and for economy both to the contractor and customer.

Porcelain products are available in scores of types to amply provide for the most extensive wiring jobs.

For details, write to the companies below.

★ **ILLINOIS ELECTRIC PORCELAIN CO.**
Macomb, Ill.

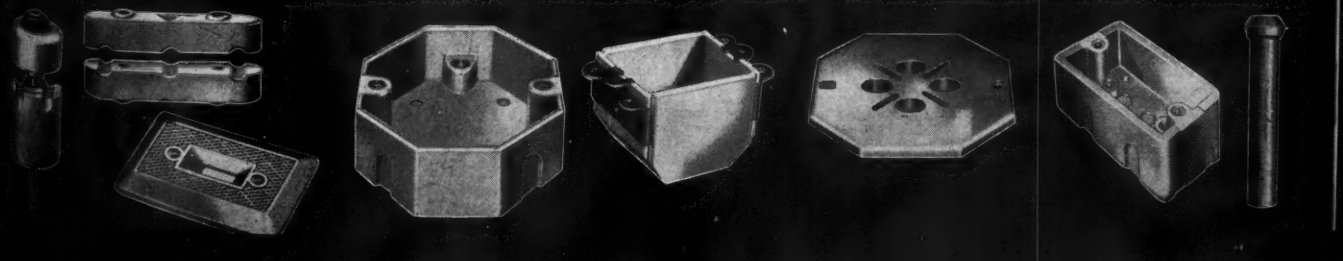
★ **PORCELAIN PRODUCTS, INCORPORATED**
Findlay, Ohio

★ **SPECIALTY PORCELAIN WORKS**
East Liverpool, Ohio

★ **SUPERIOR PORCELAIN COMPANY**
Parkersburg, W. Va.

★ **UNIVERSAL CLAY PRODUCTS COMPANY**
Sandusky, Ohio

MODERN PORCELAIN PROTECTED WIRING SYSTEMS



MODERNIZING FOR INCREASED CAPACITY

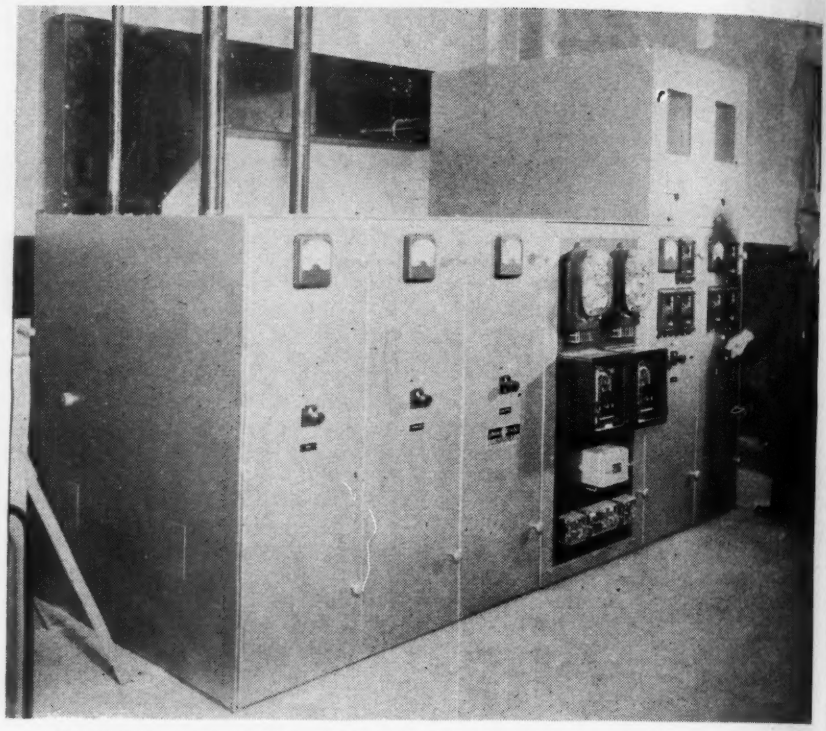
INDUSTRIAL

A plant-wide expansion program at the Hewitt Rubber Corporation, Buffalo, involved the construction of several new buildings and the installation of new equipment, some of which required large synchronous motors. A preliminary survey of the power setup indicated that additional transformer capacity would be necessary to carry the load.

The original system consisted of 12 100-kva. power transformers operating in parallel as four, three-phase banks. The lighting system was fed by six 25-kva., 110-volt, single-phase units. All this equipment and the necessary switchboards were located in a single substation. The addition of more units seemed out of the question without enlarging the station.

A thorough study of both primary and secondary switching equipment and an analysis of the interrupting capacity of primary breakers led to a decision to completely modernize the substation with new power and lighting transformers and modern switchgear equipment. Metal-clad switchgear was selected for the primary requirements and metal-enclosed circuit breakers for the secondary distribution. These replaced the existing open-type equipment and wiring in the station.

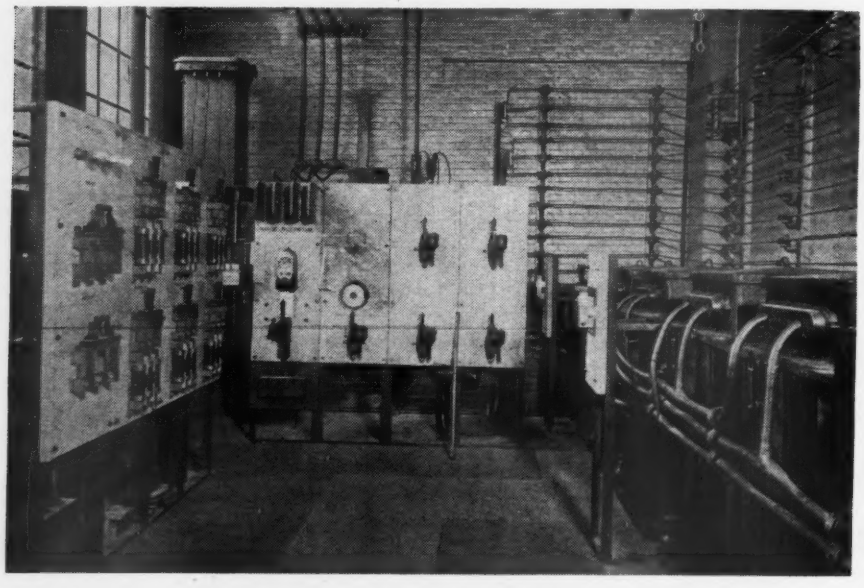
Because of the compact arrangement of the modern switchgear it was possible to locate the transformers at one end of the substation and the switchgear at the other. A fire wall through the middle of the room provides additional safety to the operators. The 2200-volt, three-phase, 25 cycle, primary equipment consists of two incoming line units, three out-going feeder units and a compartment and facilities for the power company's metering equipment.



***MODERNIZED SUBSTATION** with additional capacity is equipped with compact metal-clad, 2200-volt primary switchgear and metal-enclosed secondary switching equipment. Transformers are at one end of the room, switchgear at the other.*

The new metal-enclosed equipment and the bus trough connecting the secondary switchgear with the transformers are finished in light metallic bronze color. The interior of the room has been finished in a harmonizing color.

The installation of this compact modern equipment not only solved a space and inadequate capacity problem but assured a continuity of service that is vital to the stepped-up production of the plant.



***OLD STYLE EQUIPMENT** with live front switchboards and open wiring was inadequate to handle the additional load resulting from plant expansion. Note how equipment is spread out.*

AUTOMATIC WIRE CUTTER

INDUSTRIAL

Wire used for jumpers and in armature coils is automatically cut to predetermined lengths at the Gary Works of the Carnegie-Illinois Steel Corp. The labor saving device they developed to accomplish this is a unique apparatus that does everything but talk. All the mechanic need do is set up the reel of wire (any size or shape), set the machine for the desired length and insert the wire. The machine does the rest.

There is nothing complicated about the machine operation. A jaw (7 in the photograph) grasps the wire and draws it through friction dies and tension device (2) which straightens it out. When the jaw reaches the desired length, it stops and springs a trip (9) which starts the shear motor. The wire is cut and the piece drops into the cradle under the machine. The jaw then returns to its original position and the process is repeated until the desired number of wire lengths are cut. A counting device attached to the shear mechanism tabulates the number of pieces cut.

The sketch below shows the wiring diagrams for the draw bar traverse drive and the shear drive. The se-

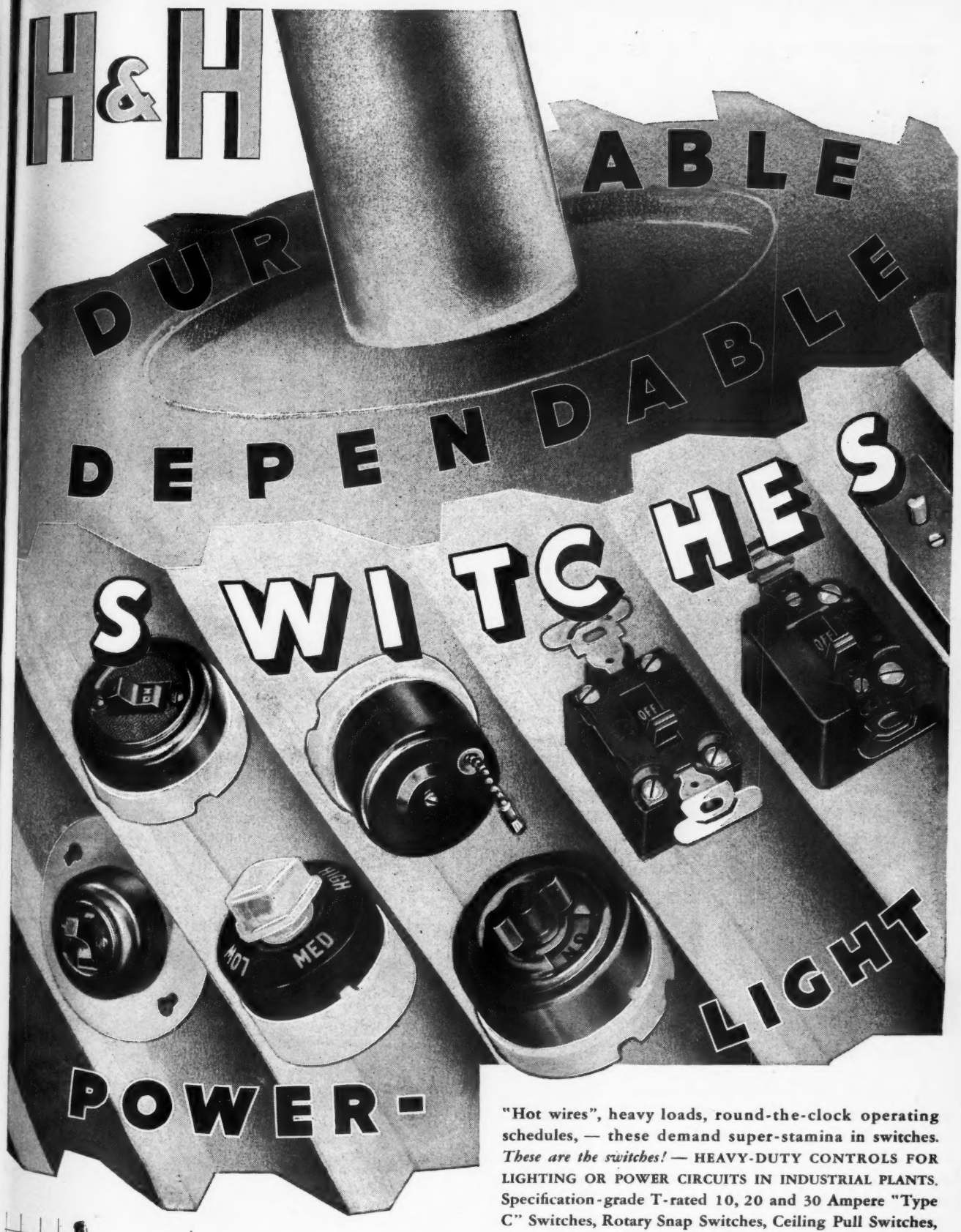
H&H

DURABLE

DEPENDABLE

SWITCHES.

POWER-LIGHT

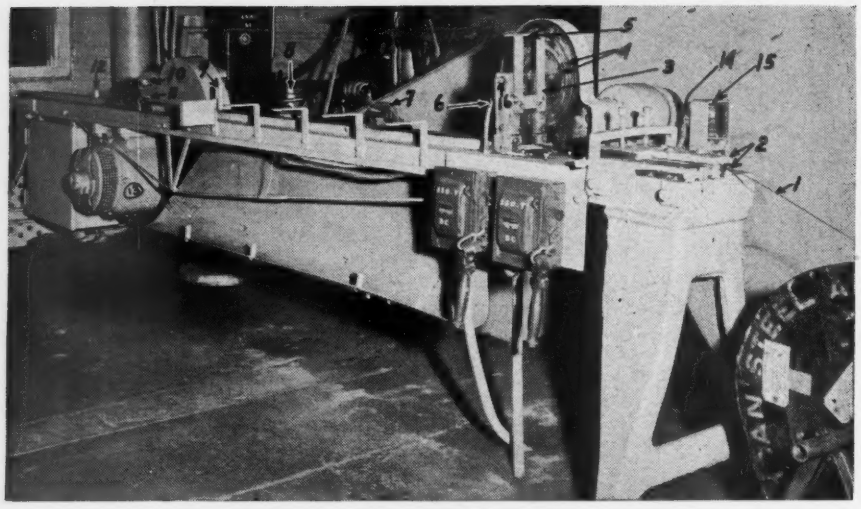


DISTRIBUTED THROUGH
ELECTRICAL WHOLESALERS

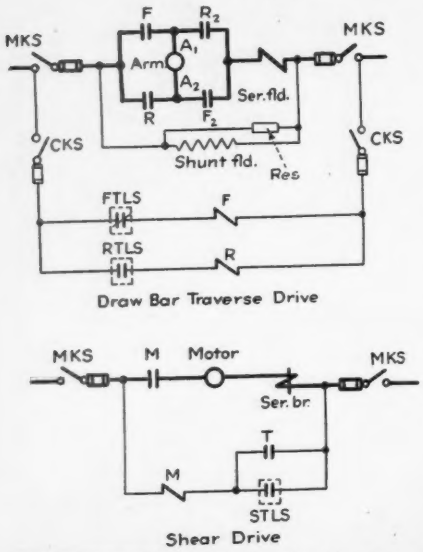
"Hot wires", heavy loads, round-the-clock operating schedules, — these demand super-stamina in switches. *These are the switches!* — HEAVY-DUTY CONTROLS FOR LIGHTING OR POWER CIRCUITS IN INDUSTRIAL PLANTS. Specification-grade T-rated 10, 20 and 30 Ampere "Type C" Switches, Rotary Snap Switches, Ceiling Pull Switches, Door Switches, Flush Tumbler Switches with or without outlet box covers. Mechanisms long-tested and singled out for the *peak* performance now so necessary. Pick them for flawless service on the critical jobs.

HART & HEGEMAN DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.



AUTOMATIC CUTTER owes its automatic operation to the following accessories: (1) wire to be cut; (2) friction type dies; (3) shear housing; (4) shear conductor rings; (5) counter mounting; (6) contactor fingers; (7) wire gripper; (8) stroke control trip; (9) shear control trip; (10) shear control limit switch; (11) stroke control limit switch; (12) reverse stroke control trip; (13) reversing motor for reciprocating gripper; (14) shear solenoid brake; (15) brake solenoid; and (16) shear crankshaft projection for counter crank.



WIRING DIAGRAM showing the electrical interlocking and control circuits for the sequence operation of the draw bar traverse and shear drives of the automatic wire cutting and counting machine illustrated above.

quence operation of the draw bar motor is as follows: The main knife switch (MKS) is closed, energizing the shunt field of the d.c. motor. The control knife switch (CKS) is closed, energizing the operating coil (F) of the forward contactor through the normally closed trip limit switch (FTLS). Contacts F and F2 are closed, allowing current to flow through the series field and the armature in the direction of A1 to A2, setting the machine in motion.

At the end of the travel, the trip limit switch is tripped, thus opening the circuit of the forward operating coil and closing the circuit of the reverse contactor coil (R). Contacts R and R2 are closed, causing the current to flow through the armature in the direction of A2 to A1, thus reversing the direction of motion. At the end of this reverse travel, the limit switch is again tripped and the forward motion is repeated.

In the interim the shear motor operates in the following sequence to cut the wire. Just before the draw bar traverse reaches its final limit, shear trip limit switch (STLS) is tripped, energizing the operating coil of the main line contactor (M) and starting the shear motor. Timing contact (T) is closed immediately, due to the motion of the motor, and affords a holding circuit for coil M. The timing contact is mechanically operated by a segment geared to the shear. Two fingers, forming the contacts of the timer and normally resting on fiber insulation, are shorted by means of the copper segment, thus maintaining contact for one complete cycle of the shear.

The machine is also used to measure, cut and count fiber slot wedges for stator repairs.

TEST CIRCUITS

INDUSTRIAL

The test and assembly floors of the Norton Company, Worcester, Mass., manufacturers of grinding machines, occupy five long bays adjacent to the machining areas. Many of the grinders are so huge and massive that they must be dismantled and shipped in sections. Because of their size, it is impossible to move the machines to a test floor for final inspection, so test facilities are provided throughout the assembly area.

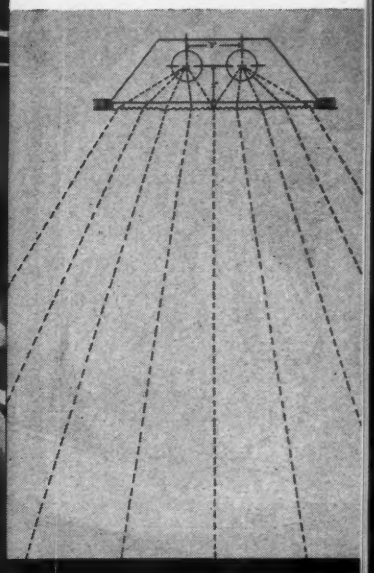
Trenches are run down the middle of each of the five assembly bays. The cement trenches are 32 inches deep, 48 inches wide and 200 feet long. The generous cross-sectional dimensions have facilitated installation and maintenance.

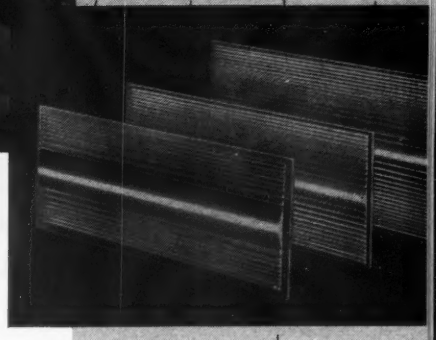
On 14-foot centers, pull boxes (24 inches by 28 inches) are located and connected by 12-foot lengths of conduit varying in size from 2½-inch down to ½-inch to carry the required circuits. The receptacles are located at the top of the trench alongside the pull-box and connected to it by flexible conduit. All services are not made available at

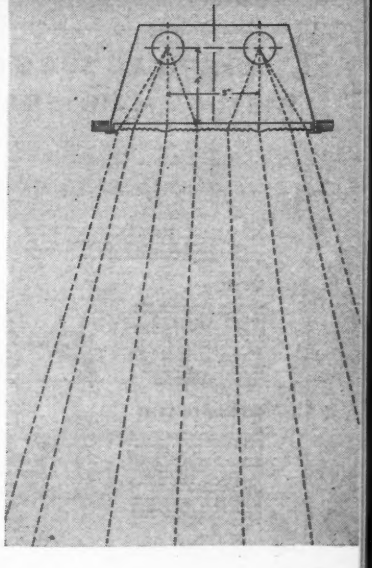
[Continued on page 167]

COPPER COLLECTOR STRAPS, which connect the silver ring bus of the aluminum pots to the steel collector rods which act as cathodes are polished on long tables such as this making use of mass production methods. Helpers lay the straps side by side in a long row while another employee polishes all contact surface with a power driven abrasive wheel. Tens of thousands of these straps were used in the construction of the New York city Aluminum Company plant.

Engineering Dept., Boeing Airplane Company, Wichita, Kans. Two tube recessed fluorescent troffer lighting units with diffusing lenses installed in continuous bands six feet apart provide glare-free illumination of 50 foot-candle intensity. Installation by Austin Co.







CORNING ENGINEERED *Flur-o-guides**

BETTER LIGHTING THROUGH GUIDED LIGHT...

SATISFIED CUSTOMERS... *more profit for you*

It's easy to sell efficient, adequate lighting, and profitable too. Recommend the correct engineered fluorescent lighting installation . . . one that is designed optically to guide the light where it is needed... to produce a concentrated or wide angle beam of light. Show your customer how an engineered installation gives adequate light without interference of glare in the normal line of vision. You can prove to him that engineered lighting is the *only* way to insure maximum see-ability with minimum brightness.

WHAT IS ENGINEERED LIGHTING?

These diagrams illustrate the functions of engineered lighting†, using Corning *Flur-o-guide** lenses and panels. In this case, placement of the fluorescent tubes in relation to the focal length of the *Flur-o-guide** lens produces wide angle light distribution (upper diagram) or concentrated light beam (lower diagram). In either case, through the use of *Flur-o-guides,** adequate light is directed where it's needed, without eye fatigue.

This is just one example of the complete line of Corning *Flur-o-guide** lenses and panels which will help you sell engineered lighting.

Write us for information on how to sell engineered lighting and thus increase your profits. Ask for your copy of "Corning Lighting Data". It's interesting and helpful. Address Lighting Sales, Consumer Products Division EC1, Corning Glass Works, Corning, N. Y.

"CORNING" is a registered trade-mark and indicates manufacture by Corning Glass Works.

**Flur-o-guides*... Lenses and Panels that are engineered to guide fluorescent light to the areas where it's needed, without eye fatigue.

†Corning Glass Works does not manufacture or sell lighting fixtures. The diagrams presented are standard types obtainable from fixture manufacturers.

CORNING means ...search in Glass

Corning Engineered Lightingware

BRAND

HERE'S THE G-E MANUAL

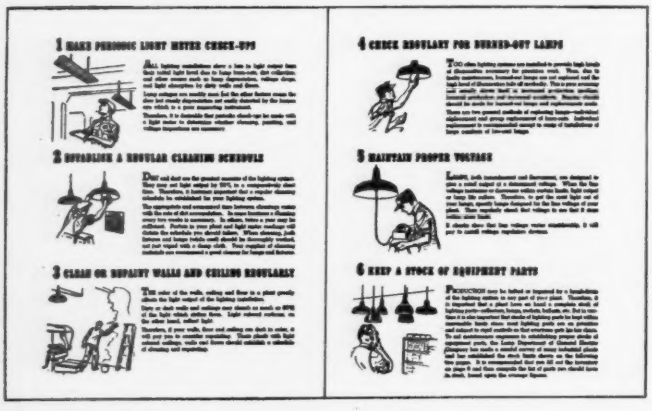
New 16-page G-E Manual sums up latest information on easier lighting maintenance — plus recommendations for adequate stocks of lighting equipment parts.

NEVER before have so many useful facts and features on lighting maintenance been put together in one concise, convenient 16-page manual.

"Seven Steps to Proper Lighting Maintenance" covers the fundamentals with a brevity and clarity that makes it outstandingly practical. All your industrial lighting customers will want a copy.

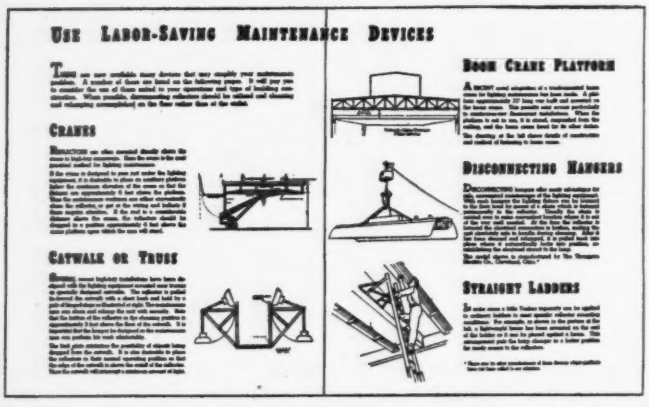
And this new G-E manual has a feature that will appeal to every lighting wholesaler and contractor who has been trying to save manpower and materials by cutting down on the frequency of special orders. It's a recommended stock of lighting equipment parts which shows your customers the lighting equipment they should keep on hand for proper maintenance.

Here are the main features of the manual, illustrated:

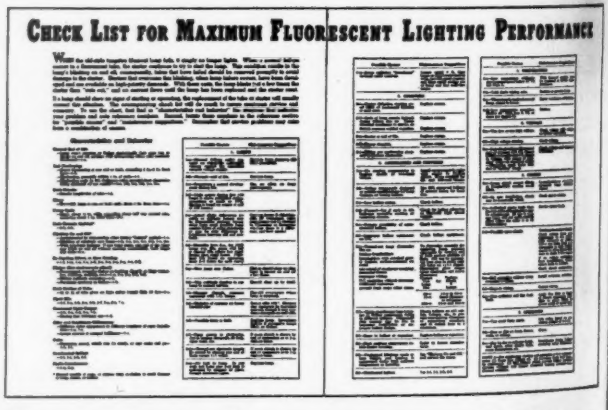

1 MAKE PERIODIC LIGHT METER CHECK-UPS
2 ESTABLISH A REGULAR CLEANING SCHEDULE
3 CLEAN OR REPAINT WALLS AND CEILING REGULARLY
4 CHECK REGULARLY FOR BURNED-OUT LAMPS
5 MAINTAIN PROPER VOLTAGE
6 KEEP A STOCK OF EQUIPMENT PARTS

1. PRACTICAL SUGGESTIONS FOR PROPER LIGHTING MAINTENANCE.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sun., 10 p.m., EWT, NBC; "The World Today" news every weekday, 6:45 p.m., EWT, CBS.



2. LABOR SAVING MAINTENANCE DEVICES.



3. FLUORESCENT MAINTENANCE CHECK LIST.

LET'S ALL BACK THE ATTACK — BUY ANOTHER WAR BOND THIS MONTH!

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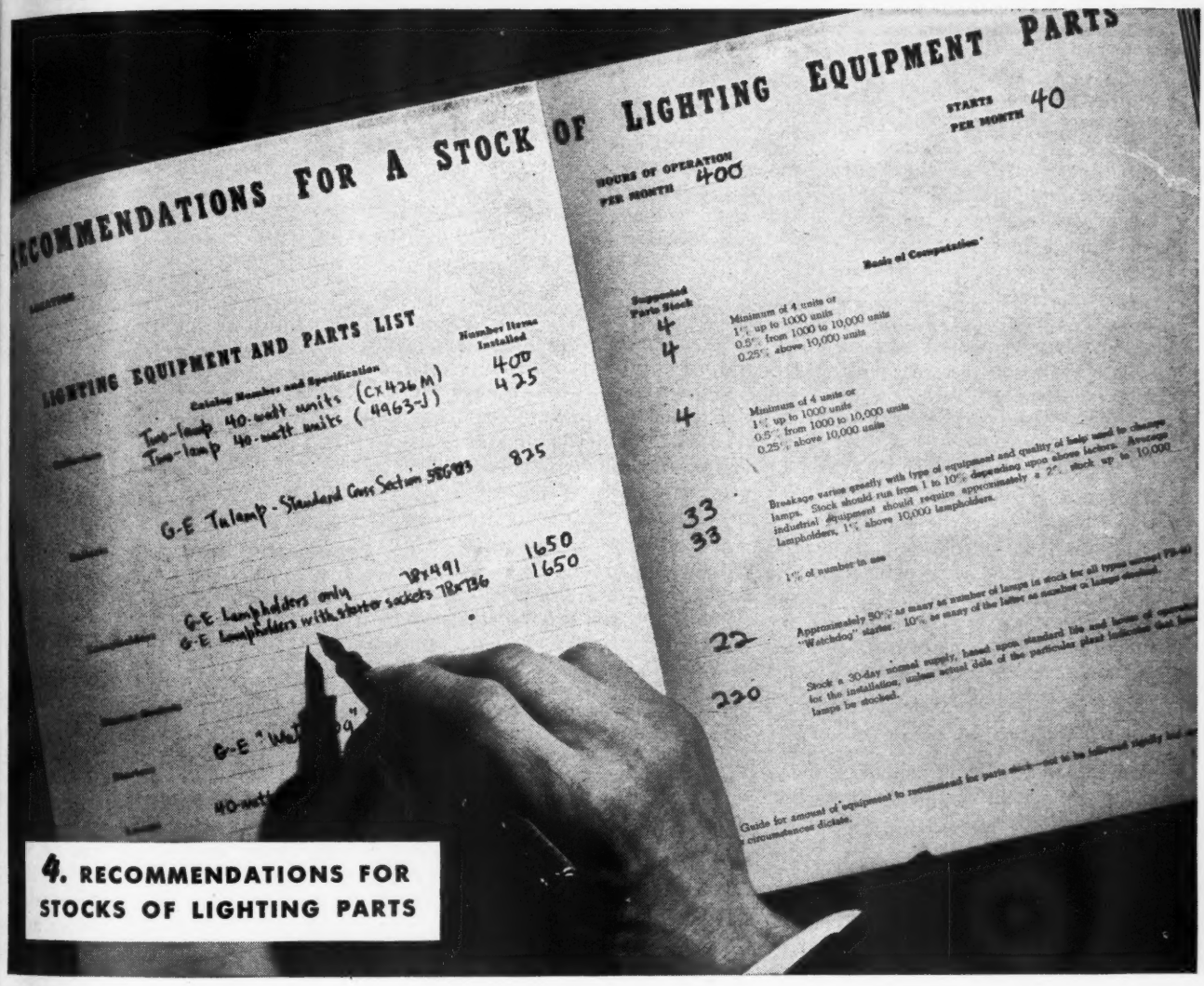
YOUR INDUSTRIAL CUSTOMERS NEED



4. RECOMMENDATIONS FOR STOCKS OF LIGHTING PARTS

"TO MAKE LAMPS STAY BRIGHTER LONGER"
The Creed of G-E RESEARCH

MAIL THIS COUPON NOW or see your G-E lamp office for your free copy of this useful manual! Quantities for distribution to your industrial customers are available through your G-E lamp office.

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Gentlemen:

Please send a copy of your new booklet, "Seven Steps to Proper Lighting Maintenance," to:

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MOTOR SHOPS

THREE-WAY DIP TANK SYSTEM

A single batch of dipping varnish supplies three different tanks in the motor service shop of Industrial Electric, Inc., New Orleans, La. The varnish is pumped from one tank into the other, depending upon which one is to be used.

This three-way development resulted from a desire on the part of the shop superintendent to allow the impregnated motor stators and rotors to drain without necessitating the use of a hoist or suspension equipment. Once the equipment is placed in the tank, the shop hoists are free for other work.

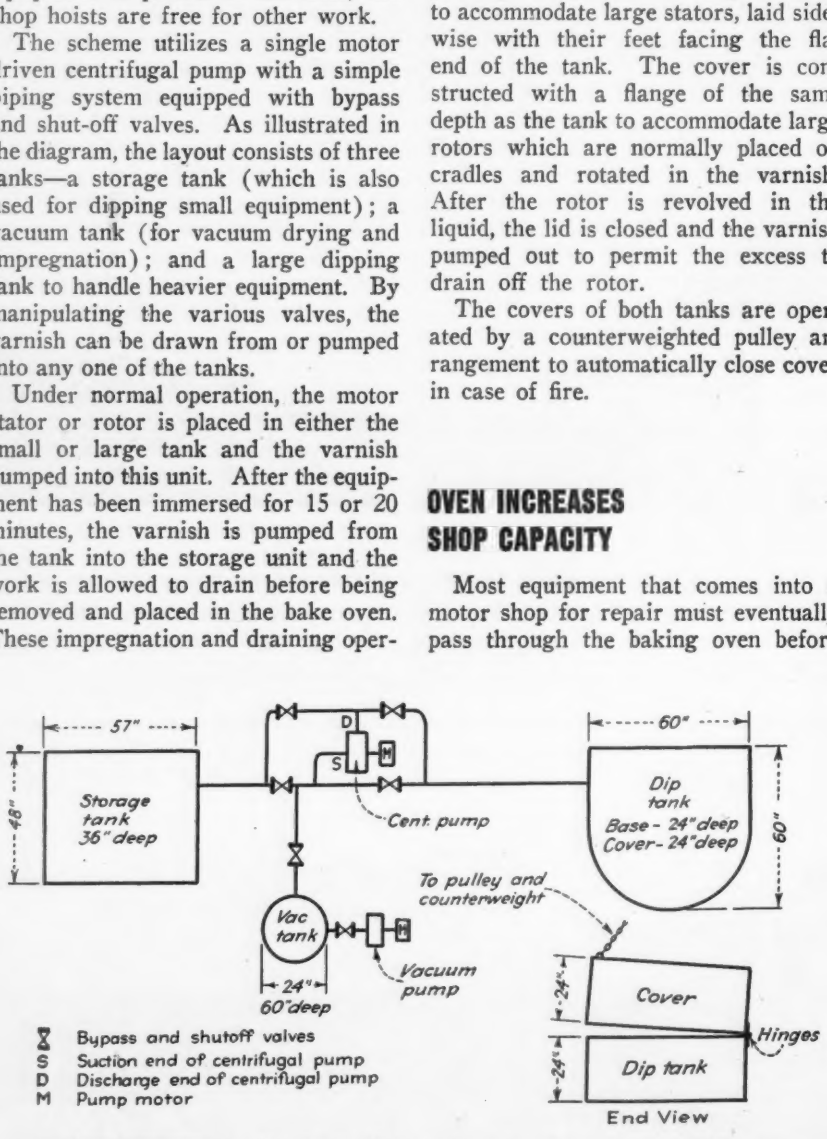
The scheme utilizes a single motor driven centrifugal pump with a simple piping system equipped with bypass and shut-off valves. As illustrated in the diagram, the layout consists of three tanks—a storage tank (which is also used for dipping small equipment); a vacuum tank (for vacuum drying and impregnation); and a large dipping tank to handle heavier equipment. By manipulating the various valves, the varnish can be drawn from or pumped into any one of the tanks.

Under normal operation, the motor stator or rotor is placed in either the small or large tank and the varnish pumped into this unit. After the equipment has been immersed for 15 or 20 minutes, the varnish is pumped from the tank into the storage unit and the work is allowed to drain before being removed and placed in the bake oven. These impregnation and draining operations are performed with the covers of the tanks closed.

When the vacuum tank is used, the equipment is placed in the tank and the cover is locked into place. The attached vacuum pump creates a vacuum which draws the varnish into the tank. The centrifugal pump is used, however, to drain the tank after the equipment has been impregnated.

With the exception of the vacuum unit, the tanks are constructed of simple sheet metal—No. 12 gage for the dip tank and heavier for the storage unit. The large dip tank is reinforced at various points with angle iron. The peculiar design of the large unit is to accommodate large stators, laid sidewise with their feet facing the flat end of the tank. The cover is constructed with a flange of the same depth as the tank to accommodate large rotors which are normally placed on cradles and rotated in the varnish. After the rotor is revolved in the liquid, the lid is closed and the varnish pumped out to permit the excess to drain off the rotor.

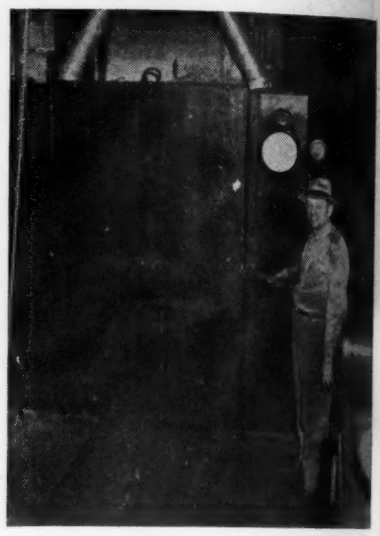
The covers of both tanks are operated by a counterweighted pulley arrangement to automatically close cover in case of fire.



***VALVE SYSTEM** in this simple piping scheme permits one motor driven centrifugal pump to fill or drain any one of the three tanks in this three-way dipping system. Work remains in tank to drain after varnish is pumped out, releasing hoisting and suspension equipment for other uses.*

OVEN INCREASES SHOP CAPACITY

Most equipment that comes into a motor shop for repair must eventually pass through the baking oven before it is returned to the customer. As a result, a small oven can become a very serious bottleneck in repair shop work, especially in times like these when customers demand quick service to get their equipment back to work.



***TEMPERATURE RECORDER** and mercoid switch can be seen just above the head of H. S. Furman who is a department manager of the Southern Electric Service Shop*

The foresight of Wallace W. Hanks prevented such an eventuality in his big shop, the Southern Electric Service Company in Charlotte, N. C. Within the last several months Mr. Hanks has greatly enlarged his shop capacity to handle increased industrial repair. And his big oil-burner oven can still take this added load right in stride.

The oven itself is built in two steel shells. The inner steel shell provides the interior side walls and ceiling and measures six feet six inches wide, 12 feet long and seven feet high. Two-inch magnesium blocks were then built over the entire exterior of the inner shell for insulation purposes. The exterior steel shell was then welded into place to secure the insulating blocks.

On the interior, lengths of angle iron 12 feet long were welded at various heights to each side of the oven. Thus, iron pipes spanning the width of the oven can be set in place to carry any number of motor coils for baking. Grate-type shelves are set on either side of the oven to carry small armatures, stators and transformers. Tracks leading into the center of the oven guide the main truck which carries all the large heavy equipment.

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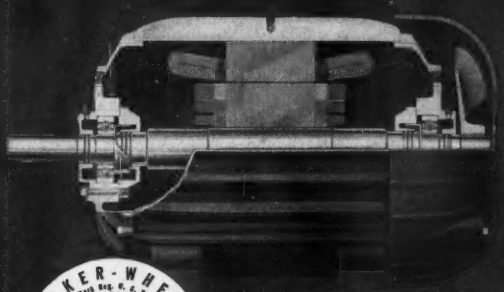
- Oil and Fat Recovery
- Flour Mills



CROCKER-WHEELER Motors-Generators

SEALEDPOWER

(Cowl-cooled) . . . available for all polyphase alternating current circuits, 2 to 15 horsepower. Write for detailed literature, or call our nearest office.

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- Wet Mines
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Now a Corrosion-Resistant *SEALEDPOWER* Motor

PROTECTED AGAINST: acid fumes, alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

PROTECTED BY: a corrosion-resistant frame, cooled by a built-in corrosion-resistant fan. The windings are *doubly* protected from damage by Crocker-Wheeler's vacuum-impregnation process which seals each coil individually against moisture, fumes or dirt.

BRUTALLY TESTED! The seal's effectiveness is proved by laboratory tests (at right) and by hundreds of satisfactory installations.

1 **SEALEDPOWER** motor was placed in tank containing several inches of water and run continuously for 8 hours (see photo). It stood idle in water overnight, then was run 8 more hours. During motor's operation, the external ventilating fan drenched the outside of the frame with water. At end of test, the motor was disassembled and found to be *completely dry* inside.

2 A dense atmosphere of extremely fine French chalk was kept circulating around the motor and through its ventilating system for many hours. No trace of chalk was found inside upon disassembly.

JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

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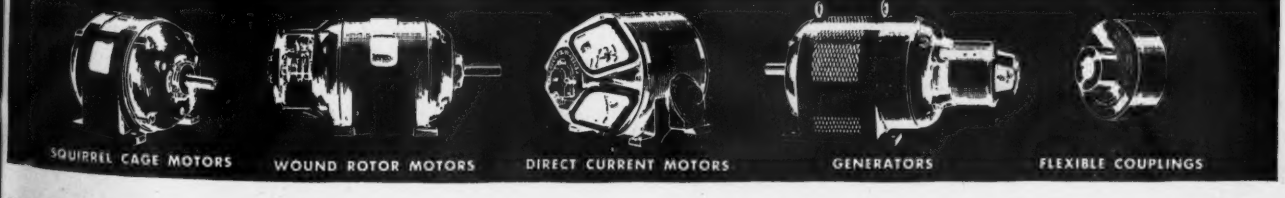
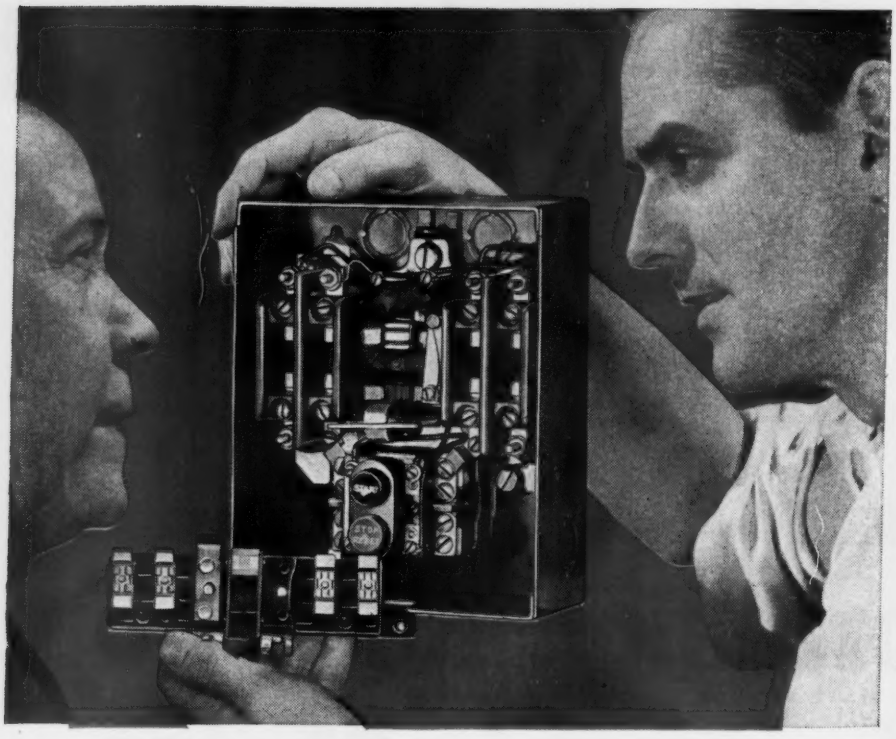


SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS



VERTICAL CONTACTS
in Motor Control

Superb Engineering...and Good Common Sense

With America's factories playing such an important part in shaping the future of mankind, *millions* of people know the vital job being done by electric motors and the resulting *importance* of dependable motor control. Thus the widespread preference for Cutler-Hammer Vertical Contact Motor Control is easily understood. Not only does the performance of *this* motor control speak for itself but the *reason* for such performance is obvious, easily appreciated, fully convincing. Electrical experts like to say the vertical contact construction in Cutler-Hammer Motor Control is superb engineering. But we rather like the way hard-boiled maintenance men put it... "Vertical Contacts make sense. I wouldn't buy any other kind of motor control". That tells the real story of an outstanding engineering achievement... why the vast majority of all electric motor manufacturers recommend Cutler-Hammer Motor Control, why leading machinery builders feature it as standard equipment, why a host of electrical wholesalers carry it in stock for your convenience. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Dust Safe

Everyone knows clean contacts are the *first* requirement for smooth-operating, dependable motor control. Anyone can see vertical contacts *can't* collect dust and dirt like horizontal surfaces —must *stay* clean and perform better.

Arc Safe

By their very design, vertical contacts form a flue or "chimney" wherein naturally induced rising air currents act to automatically extinguish the arcing which occurs when contacts are opened. This means longer-life motor control.

Service Safe

Vertical contacts are out in the open, easy to inspect, simple to service. They are designed to *avoid* the destructive effects of confined heat and arcing... do not merely *hide* them until major damage develops.

CUTLER-HAMMER
MOTOR CONTROL
C-H

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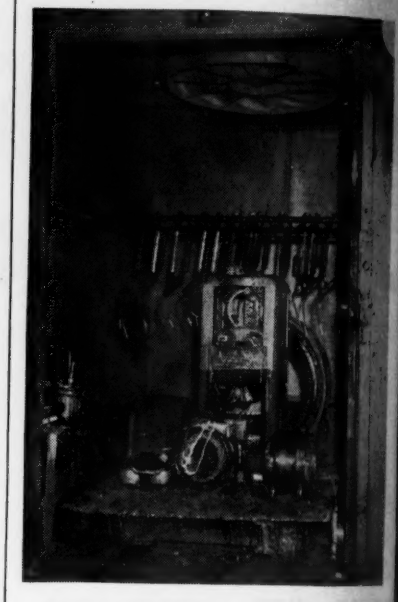
Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

At the rear of the steel-shell oven is a domestic type oil burner that furnishes the heat. The furnace gases and the oven air are kept separate. The furnace gases are baffled around the air ducts and then carried outside. The hot air is then recirculated by fan through the ducts and through the oven. Hot air comes in at the bottom in the back through a vent about one foot and a half high and the width of the oven. A three foot fan in the center of the ceiling takes the hot air



OVEN INTERIOR shows fan in ceiling for recirculating air, angle-iron supports for pipe carrying motor coils, and side racks for smaller equipment. Main truck carries heavy equipment.

out for recirculation. The recirculation air system is damper-controlled with four vents (one in each corner) to the outside. The hot gases of the furnace system are also damper controlled so that most of the heat can be taken from the gases before they are expelled to the outside air.

A motor-operated valve controls the oil feed. Thermocouples placed within the oven control the mercoid switch which in turn operates the valve giving automatic temperature control. A Taylor continuous recorder charts the temperature on circular cards for permanent record.

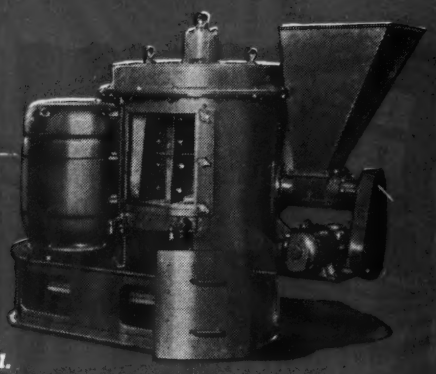
NO. 5: START-ON-LEFT-COILS

By A. C. ROE
Designer
Westinghouse Elec. & Mfg. Co.

The preceding article gave a description of the "start-on-right" coil and explained why it had been adopted as standard for wire wound coils. The second or alternative method of starting the winding of field coils is described in this article.

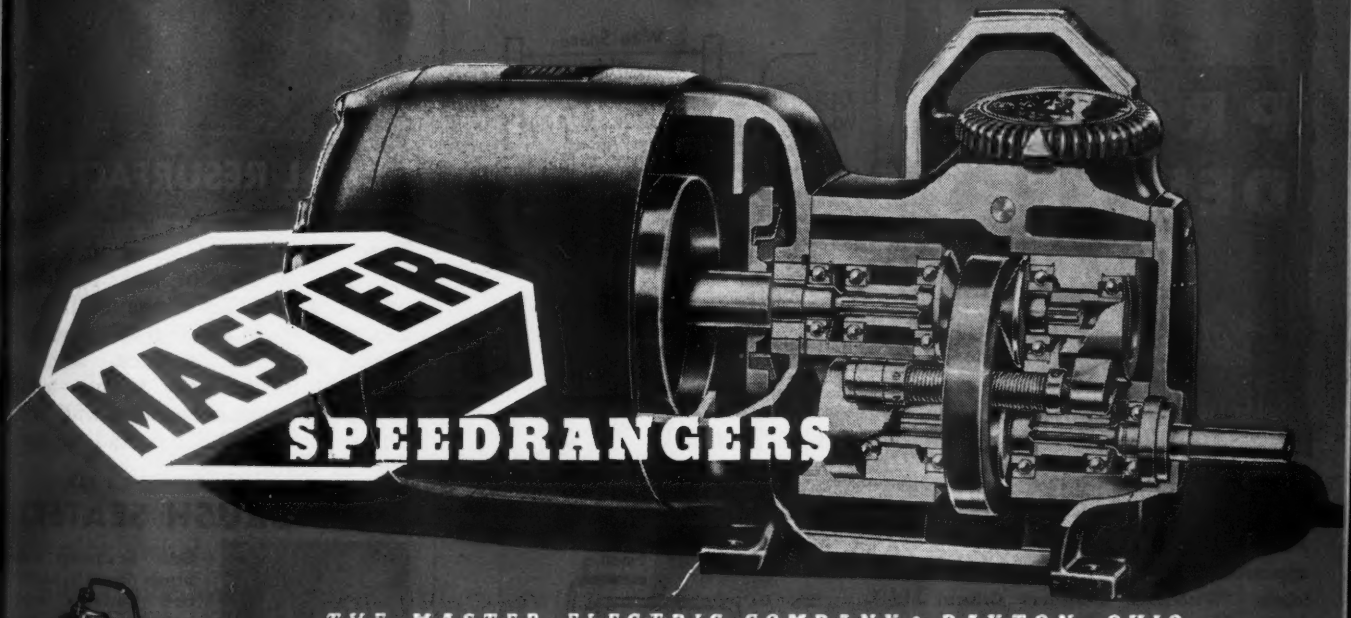
In many cases it is desirable to

BUY UNITED STATES WAR BONDS AND STAMPS



Available in sizes up to and including 3 horsepower in three different speed ranges—3 to 1, 6 to 1 and 9 to 1. Only with an all-metal drive can you secure the compactness, simplicity, flexibility and economy that are so advantageous today.

Infinitely variable speed may be secured to any R.P.M. within the range of the unit. The output speed is increased or decreased by variation of the position of the ring on the two driving and two driven cones.

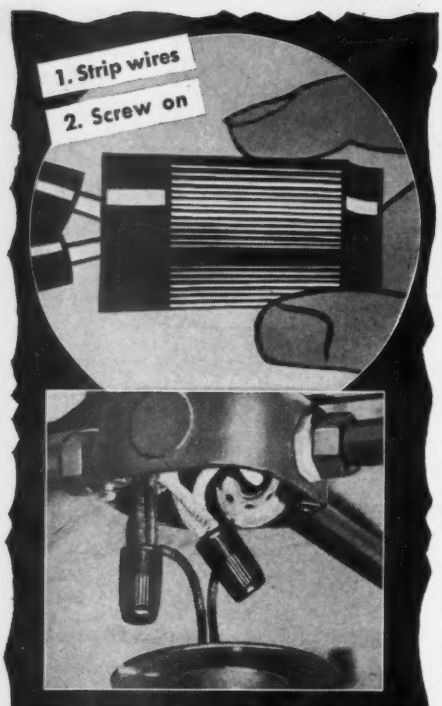


MASTER SPEEDRANGERS

THE MASTER ELECTRIC COMPANY • DAYTON, OHIO

Available in the vast number of types that make up the Master line including the flanged type as shown, also gearhead, unibrake, fan-cooled, explosion-proof, splash-proof, multi-speed, etc.

Save material and save space with the simple compact, integrally built Master Speedranger. The all-metal construction insures greatest possible durability and freedom from service interruptions.



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NO RESTRICTIONS

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arrange the taper, or finishing leads, in a manner not obtainable with the start-on-right coil. For them, the winding can be started on the left-hand side of the mold, or on the opposite side to that shown in Fig. 2 in the preceding article. In other words, as one stands facing the mold mounted on the winding machine, and with the mold revolving in a clockwise direction, the start of the first turn of the first layer is on the left-hand side of the mold. The turns in the first layer are wound on the mold from left to right. The first layer of a start-on-left coil represents the thread of a right-hand screw.

The start-on-left coil can be also wound in two halves; the difference between coils wound straight-up and wound-in-halves, was explained in a previous article.

A comparison between the start-on-

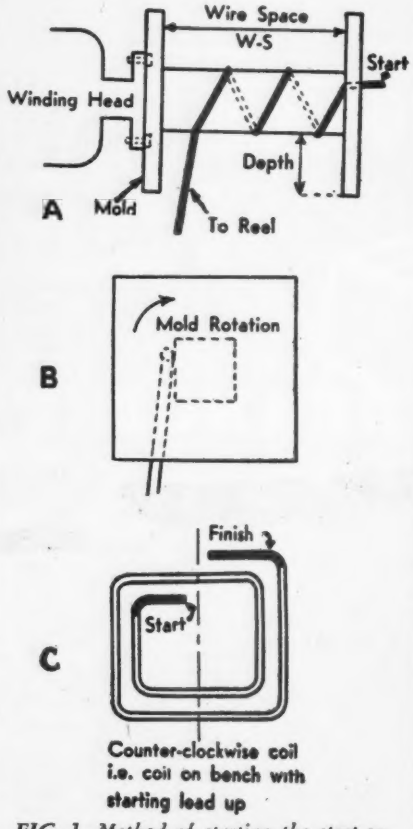


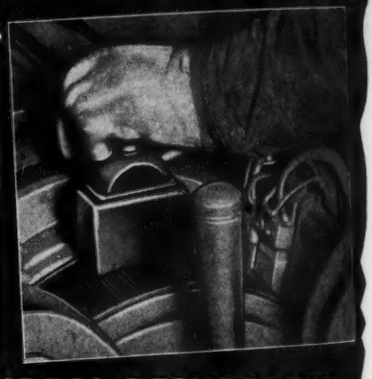
FIG. 1. Method of starting the start-on-right coils, when wound straight-up. Start at right hand side of mold and wind first layer right to left.

right and the start-on-left method of winding field coils is shown in Figs. 1 and 2. Figs. 1C and 2C represent the coil as laid flat on a bench with the starting lead on top of each coil.

Thus, Figs. 1A and 1C show that a start-on-right coil, with starting lead on top, becomes a counter clockwise coil, whereas Figs. 2A and 2C show that the start-on-left coil, with starting lead on top, becomes a clockwise coil. Thus, for same lead position the two

[Continued on page 170]

Prevent
MOTOR SHUTDOWNS
and
PRODUCTION DELAYS
with IDEAL
MOTOR MAINTENANCE TOOLS



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Keep Motors and Generators on the Job. At first sign of wear on Commutators and Slip Rings use IDEAL Resurfacers to refinish to a smooth, highly-polished surface, without disassembling. Easy to use—simply hold against surface with machine running. Sizes and grades for all conditions.

IDEAL BRUSH SEATERS

Seat or reseat each brush rapidly, easily and perfectly under actual operating conditions—without shutting down machine.

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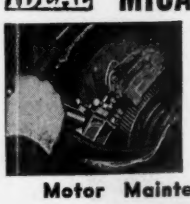
For use on surfaces badly scored, or out-of-round. Portable. Attach to brush arm supports. Run Motor. That's all.

IDEAL MICA UNDERCUTTERS



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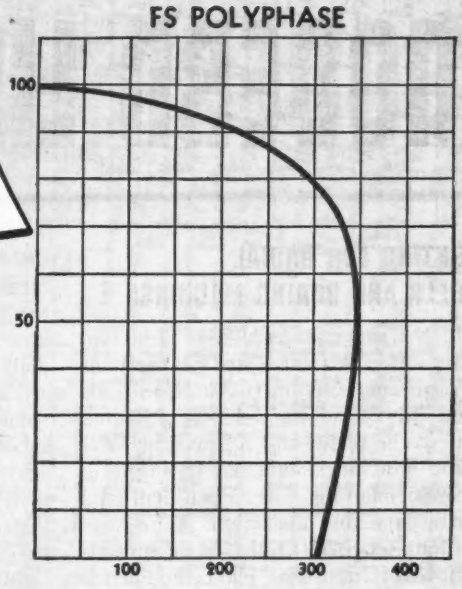
Torque Talks

ON MOTORS FOR WAR AND POST-WAR NEEDS



POLYPHASE MOTORS THAT

Tough jobs can't stop

When two or three-phase power is available, the Type FS Polyphase Squirrel-cage Induction Motor not only provides constant speed and high torque, but handles the tough, heavy-duty jobs with never a grumble.

Starting Torque of 225 to 350%—with 200 to 270% breakdown torque, in relation to running torque. These motors are designed to start on full voltage without injury, and can be reversed while in motion by use of proper reversing switch.

No commutator brushes, centrifugal switch, clutch mechanism or short circuit device—bearings and shaft constitute the *only* wearing parts.

The rugged design of the Type FS Motor makes it the ideal selection for use on machine tools, pumps, compressors, and other industrial applications. Especially recommended for fans and blowers which demand quiet operation.

ASK FOR APPLICATION HELP

Small motors have gone to war—some on wartime applications of peacetime products—many others on specialized war applications. For condensed information on Westinghouse Small Motors, the Westinghouse Small Motor Selector (Booklet 3075-A) summarizes the data presented in these "Torque Talks". Write for your copy of this helpful aid to proper motor selection. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. J-03196

PICK THIS MOTOR

- Where polyphase circuits are available
- Where constant speed is needed
- Where high starting torques are required
- Where quiet operation is desirable

Type FS Polyphase Squirrel-cage Induction Motor

PHASE—2 or 3
CYCLES—60/50 (dual frequency) or 25
HORSEPOWER—⅛ to ¾
VOLTS—110, 220, 440, 550
SPEEDS—(approximate full load rpm)
60 cycles—3450, 1725, 1140, 860
50 cycles—2850, 1425, 960
25 cycles—1425

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PLANTS IN 25 CITIES... OFFICES EVERYWHERE

SMALL MOTORS

MODERN LIGHTING

LIGHTING FOR RADIAL DRILLS AND BORING MACHINES

In the previous article the first two groups of vertical spindle machines were discussed from the standpoint of good lighting. This the sixth and final item in the series on Lighting for War Plant Machines will cover lighting recommendations for radial drill and boring machine operation. The suggestions set forth are based on investigations of industrial plants conducted by a committee of lighting engineers in the Chicago area and compiled by the Chicago Lighting Institute in cooperation with the local WPB office. Ernest E. Elliott, Lighting Engineer, Benjamin Electric Mfg. Co., Chicago, presented these recommendations at sessions held for industrial representatives at the Institute.

Radial Drills—involve the use of numerous jigs and fixtures in the work they perform. However, there is also a great deal of layout or job drilling done on these machines necessitating proper lighting for good seeing conditions. Objections voiced in the plants visited centered about the fact that, under usual methods of lighting, the large mass of the drill head shadows the drill point and prevents the operator from knowing whether or not the drill is creeping.

This difficulty is being overcome by some manufacturers, one of whom is incorporating lights in the bottom side of the head to shine directly on the drill point. Where this is not the case, many operators are using extension cords with bare lamps, or even flashlights to overcome this difficulty. Management in general and operators dislike this scheme because of the personal risk involved, the wasted time and general unsatisfactory results obtained. Even when the drill points are illuminated in this manner, the feed dials and other adjustments on the machines are left in relative darkness.

Recommended Lighting—for this type of operation is the installation of a two-lamp fluorescent fixture on and slightly above the radius arm to direct light down on the dials and adjustments and at the same time illuminate the drill point. In the case of the radial drill, this fixture will not interfere with loading cranes or hoists since the arm and its fixture is pushed out of the way when a crane is used to place work in the machine.

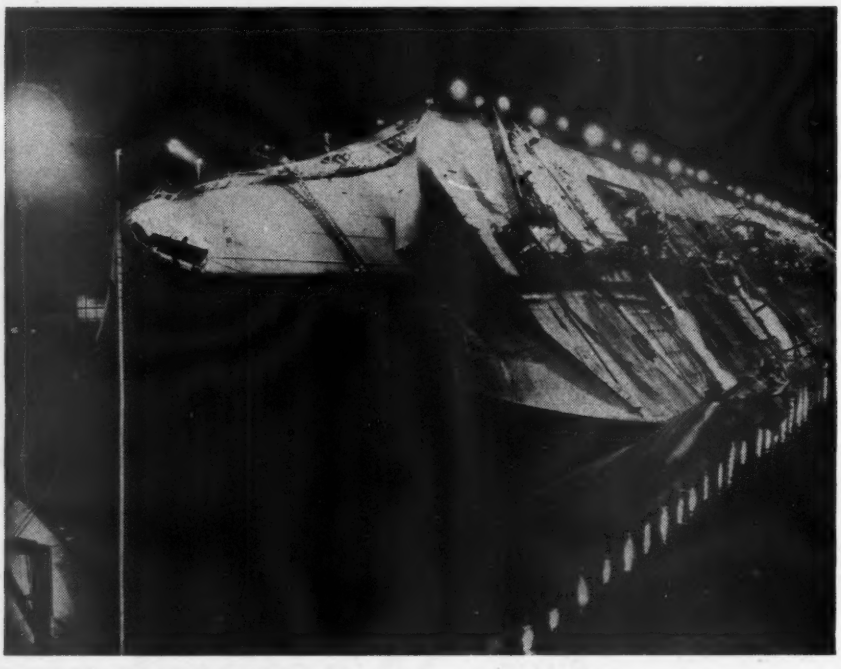
In the case of flat work, one fixture mounted in front of the radius arm would be satisfactory, but with many pieces of work the drill is behind barriers or overhanging portions of the casting. A fluorescent fixture mounted on *both* sides of the arm will solve the problem by lighting both the front and rear of the drill.

Boring Machines—present an element of personal risk which is absent with most drills since the work instead of the drill revolves. With irregular work having projections of various sorts, there is a real danger of the operator over-reaching himself and being caught by the projections. This is particularly true of high-speed machines working on brass, aluminum and other high-speed materials.

While these machines do not present the same opportunity of getting the fixtures out of the way when placing or removing the work, as in the case of the radial drill, there is still the same demand for high-intensity, high-quality light for the drill points and machine adjustment. A partial solution of this difficulty was observed in one shop where two 300-watt fixtures were mounted on 5-ft. spacing directly above the table. Another shop had a still better solution—the installation of three, two-lamp, RLM fluorescent fixtures mounted on three sides of the rectangular machine.

The above solutions would be satisfactory for ordinary ceiling heights. With large mills in high bay areas, where the work is placed on the machine and withdrawn vertically, it would be impossible to mount the fluorescent fixtures as outlined. Recourse, therefore, must be had to projection equipment properly louvered, mounted above the craneway and pointed at the work.

Recommendations for Large Mills—include the use of three, 500-watt projectors mounted ahead of the frame of the boring mill so that the light is pointed into the fed dials and the cutting points at an angle of not less than 20 degrees. If, due to wartime restrictions, these projectors are unobtainable a compromise might be made by using PAR 300-watt projection lamps—similar to sealed-beam auto headlights.



***SALVAGE OPERATIONS** were carried out on a 24 hour schedule which finally ended in the refloating of the famous French luxury-liner Normandie now christened the U.S.S. Lafayette. Illumination for night work was had by flooding the top-deck with light from thirty-four G.E. L-45 floods. Reflectors were hung on arms spaced on 30 foot centers along the edge of the top deck. Forty-six 1500 watt floodlight units were bracketed on flanking piers for additional illumination.*

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Industrial and commercial-type Certified FLEUR-O-LIERS are made in a wide variety of sizes and designs by many leading fixture manufacturers. And all have been tested, checked and Certified by Electrical Testing Laboratories, Inc. of New York as meeting 50 definite standards for electrical, mechanical and lighting excellence.

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FLEUR-O-LIERS combine not only the best features of prewar equipment, but improvements developed to help the war effort. And, of course, all FLEUR-O-LIER manufacturers conform to WPB limitation orders in the use of critical materials. Fleur-O-Lier Manufacturers, 2122-3 Keith Bldg., Cleveland, O.

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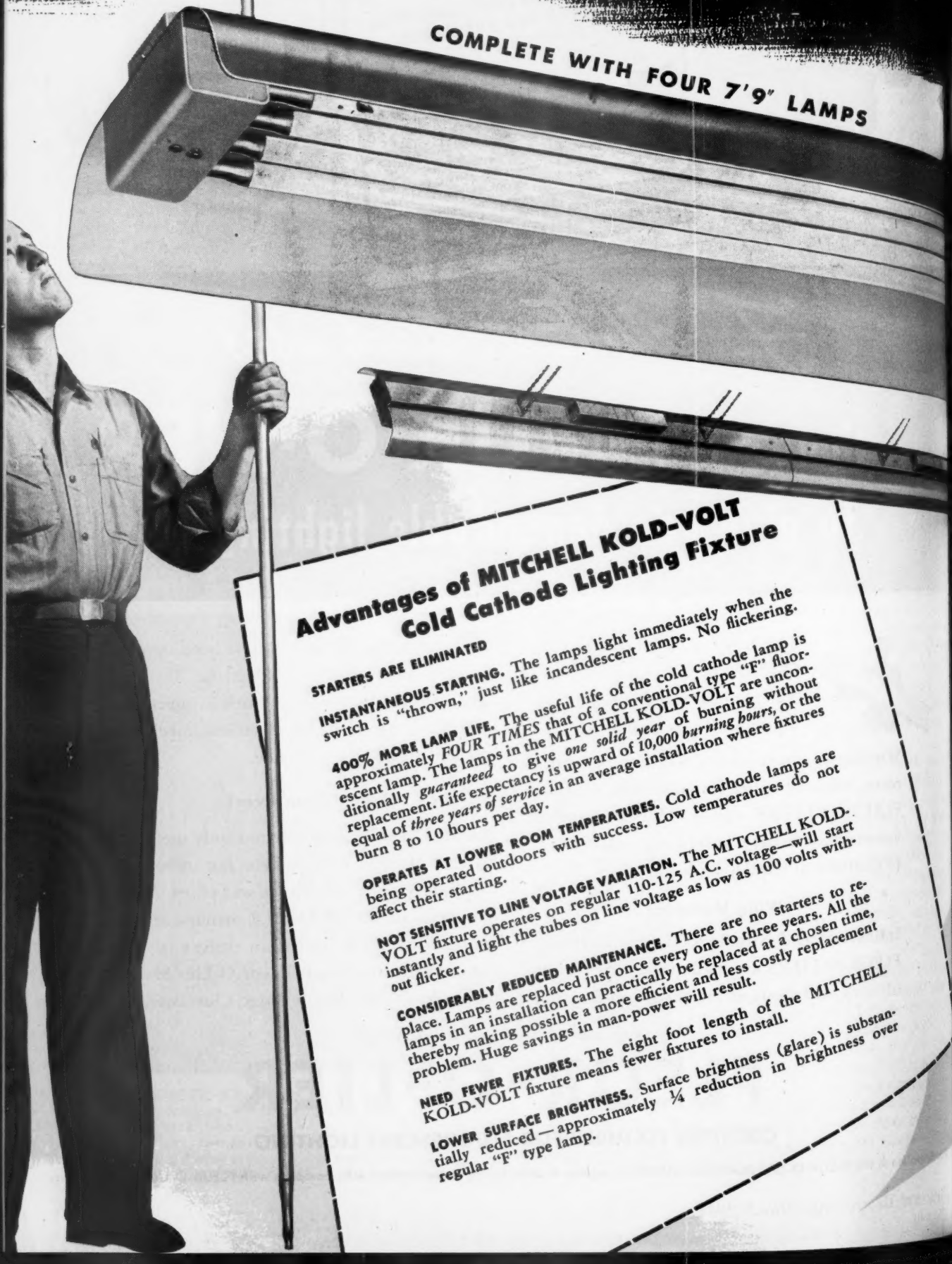
MITCHELL *Introduces* KOLD-VOLT



Advantages of MITCHELL KOLD-VOLT Cold Cathode Lighting Fixture

STARTERS ARE ELIMINATED

INSTANTANEOUS STARTING. The lamps light immediately when the switch is "thrown," just like incandescent lamps. No flickering.

400% MORE LAMP LIFE. The useful life of the cold cathode lamp is approximately *FOUR TIMES* that of a conventional type "F" fluorescent lamp. The lamps in the MITCHELL KOLD-VOLT are unconditionally *guaranteed* to give *one solid year* of burning without replacement. Life expectancy is upward of *10,000 burning hours*, or the equal of *three years of service* in an average installation where fixtures burn 8 to 10 hours per day.

OPERATES AT LOWER ROOM TEMPERATURES. Cold cathode lamps are being operated outdoors with success. Low temperatures do not affect their starting.

NOT SENSITIVE TO LINE VOLTAGE VARIATION. The MITCHELL KOLD-VOLT fixture operates on regular 110-125 A.C. voltage—will start instantly and light the tubes on line voltage as low as 100 volts without flicker.

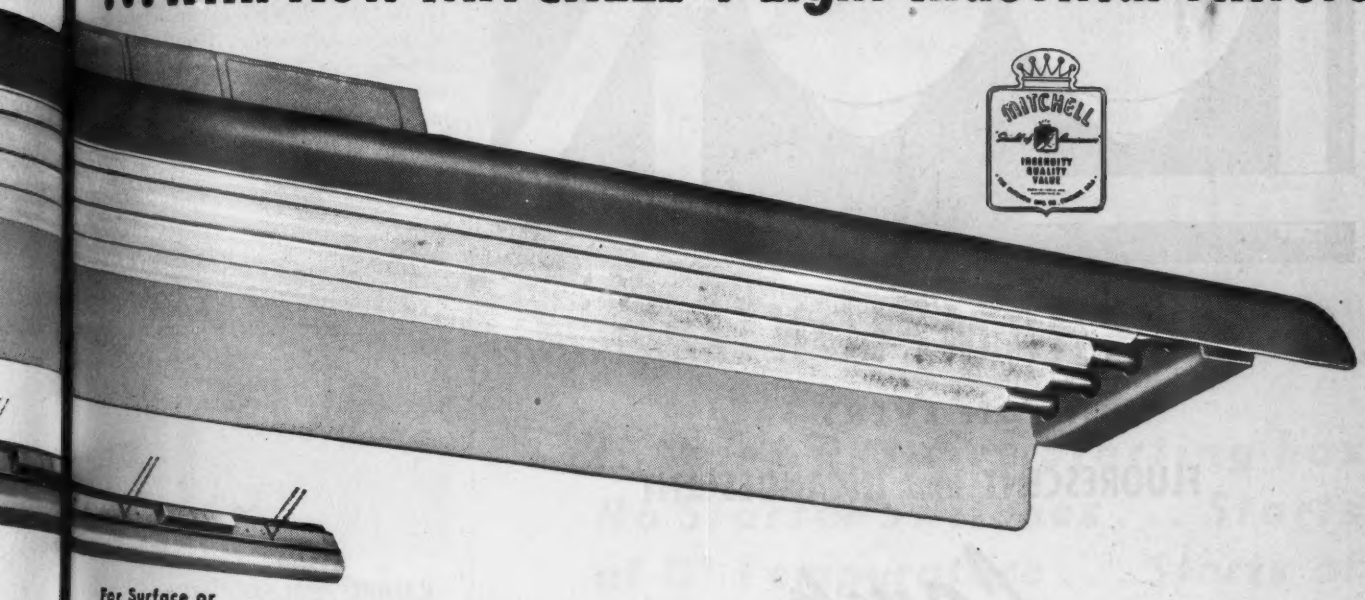
CONSIDERABLY REDUCED MAINTENANCE. There are no starters to replace. Lamps are replaced just once every one to three years. All the lamps in an installation can practically be replaced at a chosen time, thereby making possible a more efficient and less costly replacement problem. Huge savings in man-power will result.

NEED FEWER FIXTURES. The eight foot length of the MITCHELL KOLD-VOLT fixture means fewer fixtures to install.

LOWER SURFACE BRIGHTNESS. Surface brightness (glare) is substantially reduced — approximately ¼ reduction in brightness over regular "F" type lamp.

The First Cold Cathode Fluorescent in a Packaged Unit

Instantaneous Starting! 4 Times More Lamp Life! ...with New MITCHELL 4-Light Industrial Fixture!



For Surface or Suspension Mounting, Individually or in Continuous Rows.

For the first time—cold cathode lighting is now available to all industry in a standard, "packaged" unit! The MITCHELL KOLD-VOLT industrial fixture brings you the advantages of *instantaneous starting—400% more lamp life—greatly reduced maintenance!*

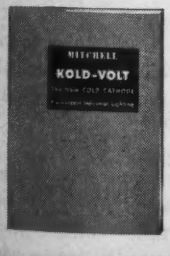
Cold cathode lighting is *fluorescent lighting.* The cold cathode lamps used in the MITCHELL KOLD-VOLT are similar in appearance and general lighting qualities to the regular conventional "F" type fluorescent lamps. They are 7' 9" long, 1" in diameter, and employ a different type of cathode.

Cold cathode lighting is *time-tested.* Its benefits were formerly available only for special custom-made lighting jobs. Recognizing the advantages this type of lighting brings to industry (see opposite page), MITCHELL today has developed a lighting unit which takes cold cathode out of the "luxury class" and makes it generally available for industrial use at moderate cost.

One MITCHELL KOLD-VOLT fixture does the work of two conventional fluorescent fixtures of the 2-40 watt "F" type. It is 8 feet long overall, uses 4 "Colovolt" cold cathode low voltage fluorescent tubes, delivers a total of 8800 lumens of light. Average lamp life expectancy is 10,000 hours, each lamp unconditionally guaranteed for one full year. The unit has a sturdily constructed heavy gauge steel wireway channel, with two Duo Ballasts. Can be mounted individually (surface or suspension) or can be attached in end-to-end continuous rows for long lines of glare-free, uninterrupted light. Reflector is famous non-metal "Lumenite," baked enamel white inside, attractive gray outside. Operates from 110-125 volts, 60 Cycle, A.C. Power factor 99%. Stroboscopic corrected. MITCHELL KOLD-VOLT comes to you complete with 4 lamps, wired ready for hanging.

Write immediately for **MITCHELL KOLD-VOLT CATALOG No. 278**

Get complete information about the lighting performance, construction, maintenance and other features of the new MITCHELL KOLD-VOLT cold cathode industrial fixture. Write for Catalog No. 278 today!



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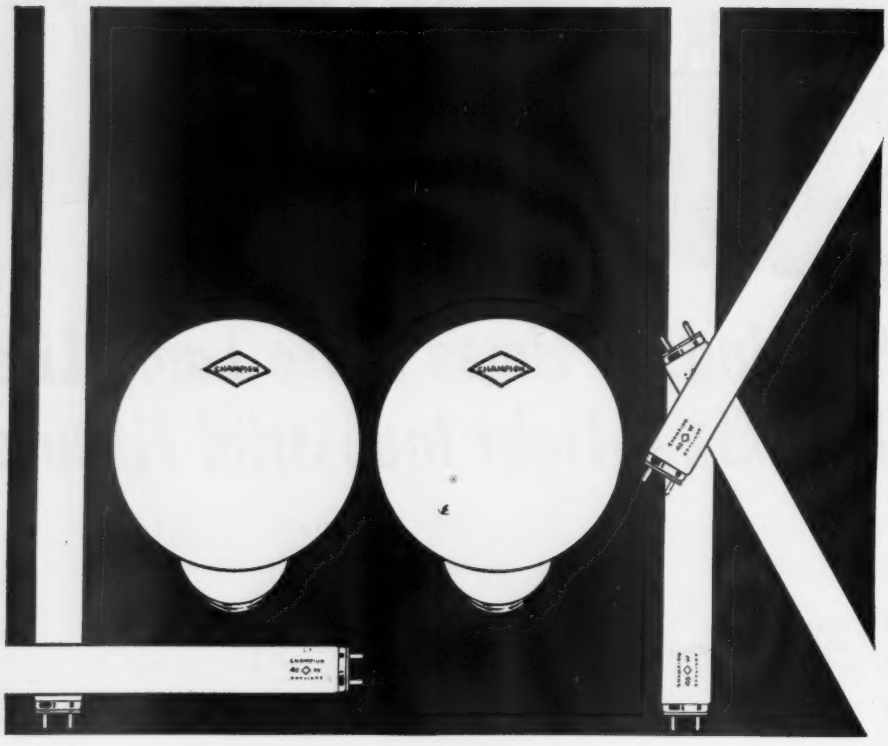

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1. **CHAMPION QUALITY**—backed by the complete, modern production, testing and engineering resources of one of the country's largest organizations specializing in fine lamp manufacture since 1900.
2. **CHAMPION SERVICE**—equipped to provide the one best *Fluorescent* or Incandescent Lamp for each individual requirement; with a field force of trained experts quickly available for consultation and assistance on any lamp or lighting problem.
3. **CHAMPION ECONOMY**—the CHAMPION diamond mark on every lamp is recognized as a symbol of lower light and lamp costs.
4. **CHAMPION AVAILABILITY**—through competent local industrial supply houses equipped to meet your needs promptly, effectively and economically.

Look for the CHAMPION Diamond. Remember what it stands for.

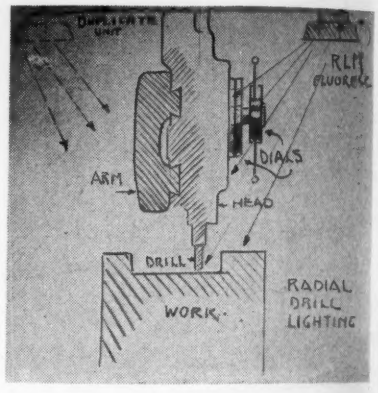
CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

Contrast Painting—of drill presses, radial drills and other machinery is a new scheme that is rapidly finding application in industry in general. Cast objects are generally handled on such machines and, being of a dark grey color, blend in with the machine to make the seeing task at the work area doubly difficult. Painting the drill press a light color to produce a contrast between the machine and the work helps define the work; and produces additional reflected light from the machine surfaces which aids in illuminating the drill, jig, and work.

If this is done, it is suggested that the machines be repainted every 6 to 12 months, depending upon the type of lubrication used. The combination of paint and light does not end here. Better seeing conditions and hence better production will result if the walls, ceilings, columns and structural



***RADIAL ARM FIXTURE** mounted to the arm of a radial drill illuminates the feed dials as well as the drill point. A duplicate fluorescent unit mounted on the back of the arm directs light to the rear of the drill point.*

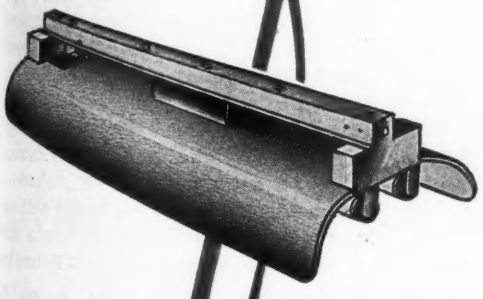
members in a given area are painted mill white down to a point at least three feet from the floor.

Lubricants—also enter into the lighting problem. These lubricants range from very dark, almost black heavy oil up to light creamy coolants composed mainly of emulsified oil and water. The choice of lubricant is primarily a matter of trial and experience and the cutting job to be done. It is revealed that the emulsified types have very definite limitations.

From the lighting standpoint it is desirable to use light-colored coolants wherever possible. The difficulty of properly lighting a drill press or boring mill increases when dark heavy lubricants are employed.

Brightness Contrast — between natural light and surroundings is also another important consideration in drilling operations. Wherever possible, operators should not face windows. In large area installations this is not always practicable and here contrast painting of machines and painting of

New INSTA-START Fluorescent Industrial



Instant-Positive Starting has No Starter Switches . . . Starts at 0° Temperature . . . Starts at Lower Voltages . . .

This new super-powered lighting unit operates standard 40 watt and 100 watt Fluorescent Lamps. Its insta-start ballast is made and guaranteed for a full year by a leading manufacturer of electrical transformers.

Insta-start units reduce maintenance by the elimination of starter switches. Turns on and off like an incandescent lighting fixture.

Will operate as low as 85 volts, which is important in plants where load capacities are a problem.

Insta-start units will operate at zero temperatures. Lamps will not blow-out in cold drafts.

Investigate this new Fluorescent Insta-start lighting unit today. Obtainable for immediate delivery.

INSTA-START OUTSTANDING 50-A-SERIES FEATURE . . .

1. It's easier to install with this new rigid simplified construction.
2. Entire wireway and ends may be exposed quickly, without taking fixture down.
3. May be surface-chain or stem mounted singly or in continuous runs.
4. Exposed ballast gives longer life and cooler operation. Inverted holder channel.
5. Special K.O. pull switch is provided in lamp holder cover.
6. Complies with W.P.B. and U. S. Bureau of Standard regulations.
7. Reflectors of masonite—formed and finished under exacting specifications in our own plant.
8. Underwriters' Laboratories approved and bear their labels.
9. Union Made—International Brotherhood of Electrical Workers, A. F. of L. Bear their label.

Open and Closed Type Commercials

A new outstanding line of L. P. I. Commercials, ideally suited for drafting room, office or other essential locations, is now available with either Conventional or Insta-Start Ballasts. Write today for bulletins describing these new fixtures!

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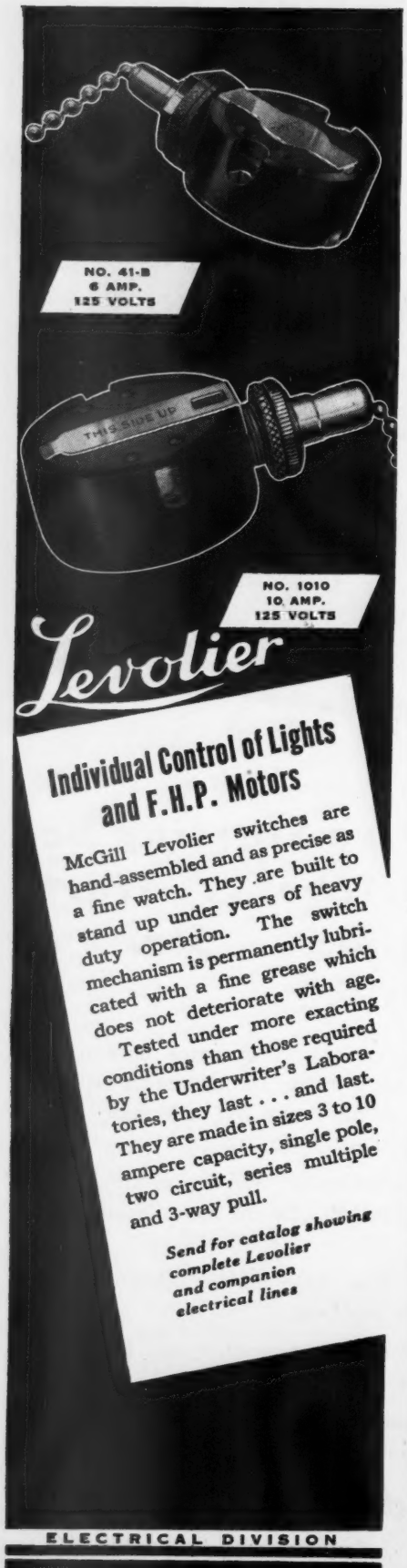
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THIS SIDE UP
NO. 1010
10 AMP.
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Tested under more exacting conditions than those required by the Underwriter's Laboratories, they last . . . and last.
They are made in sizes 3 to 10 ampere capacity, single pole, two circuit, series multiple and 3-way pull.
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interiors should be employed to raise the illumination level until the brightness of the workers' surroundings is similar to that of the window exposure. Lighting men know that operators should not be subjected to brightness contrasts of over 10 to 1 in the field of vision. Preferably this ratio should be 5 to 1.

The revelation of one case investigated will be sufficient to illustrate the point. The employees were obliged to face large windows facing the west. At two o'clock in the afternoon, with a hazy sky, the brightness of these windows was measured and found to be 3,200 foot-lamberts (about twice as bright as a 40-watt fluorescent lamp). These same operators were working in surroundings where the brightness was less than four foot—lamberts—an extremely trying working condition. The condition at 5:00 p.m. on a bright day with the sun at or near the horizon would really be distressing. The solution is the use of paint as outlined above.

FLUORESCENTS EXPEDITE SHOPPING SELECTIONS

Recessed two-lamp continuous rows of lighting equipment produce an even, well diffused level of light averaging 35 ft-c (see photo). All show cases, wall cases and niches are lighted to a high level of intensity with soft white fluorescent. Stair to lower floor has decorative lantern and stairs are spotlighted with recessed ceiling spots. Light orchid walls, light terrazzo floors, with a generous application of tinted mirrors, complement the soft white fluorescent lighting and combine to make a beautiful interior. The high level of light definitely tends to speed up shopping and enables customers to make selections accurately and quickly. This installation was made by Robinson Electric Company for J. B. Ivey and Company, Charlotte, N. C. department store.

LIGHTING FOR SHEET METAL FABRICATION

A set of recommendations for specific lighting for sheet metal fabrication was recently presented to representatives of this industry in the Chicago area by E. R. D'Olive, Illuminating Engineer, at a special session held at the Chicago Lighting Institute. The data was compiled by a committee of illuminating engineers who investigated lighting conditions in local industrial plants, under the joint sponsorship of the Chicago Lighting Institute and the local WPB office.

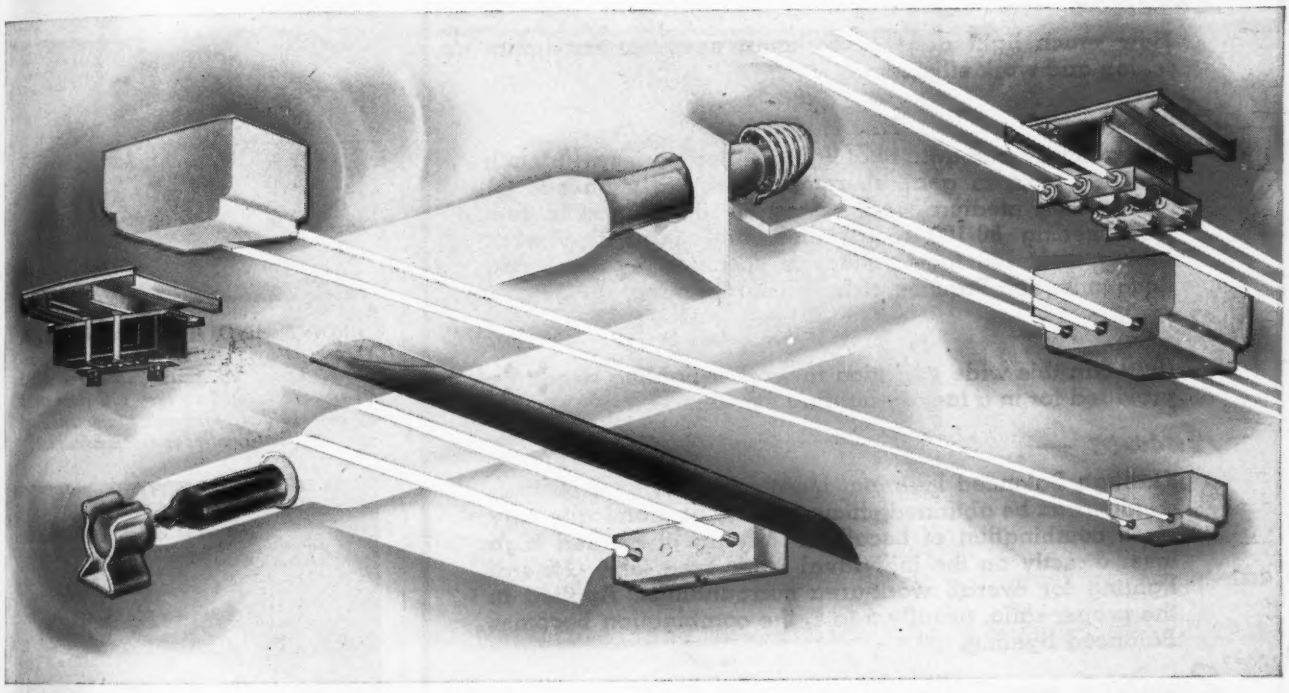
The discussion includes lighting for squaring shears, hand and power brakes, punch and forming presses and other machines in the same category. For the purpose of simplicity this first item will deal specifically with the squaring shear and the brake.

Squaring Shear—The usual squaring shear has a slot or throat varying in size from $\frac{5}{8}$-inch to $2\frac{5}{8}$-inch, located between the "hold-down" yoke or beam and the shear blade. Proper illumination for seeing the scribe mark should be provided by a 50-watt mill type lamp in a deep bowl reflector mounted as close to the yoke as possible. Several of these units will be required if the shear is long—four being recommended if the shear is 10 feet long. Lighting of this specific type causes the upper shear blade to cast a shadow which coincides with the lower cutting edge. This shadow thereby marks the point of adjustment at the scribe marks for accurate cutting.

The front scales are arranged at right angles to the shear and may be four feet or more in length. Such scales

NOTE HOW SHOW case fixtures bring out merchandise details. Satisfactory selection not only speeds purchase, but reduces the number of returns for exchange.

Turn "lumen hours" into "lumen years"



...THE NEW COLOVOLT *Lamp*

COLD CATHODE LOW VOLTAGE

8000 HOURS of rated life is what the new COLOVOLT lamps offer you! Is it any wonder that we say "lumen hours" turn into "lumen years" with cold cathode low voltage fluorescent lighting the new COLOVOLT way!

8000 hours of rated life (guaranteed for one year) insures *low maintenance* cost, which means maximum lighting efficiency, actually *greater than any previously known cold cathode lighting.*

Operation is on *low* voltage, eliminating high voltage wiring and bulky transformers (although lamps may be used for high voltage operation if desired). Moreover, COLOVOLT lamps start up immediately—require no starters. Colovolt illumination is constant—steady and unaffected by shock or vibration. The lamps are free of "strob" or flicker when used on capacitative and inductive reactor.

Available in standard 7 ft. 9 in. lengths, these lamps give longer light sources . . . better line lighting. As package items, the lamps compare most favorably with custom-built cold-cathode lighting in every respect! All of the special features of COLOVOLT are possible only because absolutely new lighting principles are employed.

Send today for booklet "Facts About Cold Cathode Low Voltage Lighting" . . . written in concise, understandable terms. Booklet tells where and how to use cold cathode (low or high voltage) lighting. Complete with performance charts and data to give a comprehensive picture of the advantages *and the disadvantages* of cold cathode fluorescent lighting for all types of lighting problems. Request your copy today!

GENERAL LUMINESCENT CORPORATION

638 SOUTH FEDERAL ST., CHICAGO, ILL.

LIGHT ON CRITICAL "SEEING" PROBLEMS

Question —

How much light does a workman need for maximum seeing and work efficiency?

Answer —

The quantity and quality of light needed varies with each worker's task. In general, rough work seeing needs 20 footcandles, medium work seeing 30-50 footcandles, fine work seeing 50-100 footcandles, and extra fine work seeing over 100 footcandles, as specified by American Recommended Practice of Industrial Lighting.

Question —

How can this wide variation in worker lighting needs be provided for in a factory lighting system?

Answer —

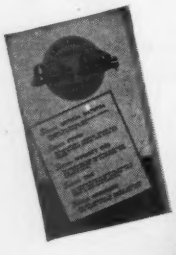
Through Balanced Lighting. Lighting levels over 50 footcandles can be obtained efficiently and economically only by a combination of Localized lighting of needed high level directly on the individual work area, and General lighting for overall work-area surroundings. Applied in the proper ratio, usually 5 to 1, the combination becomes Balanced lighting.

Question —

Who should survey our plant lighting needs?

Answer —

Put your illumination problems in the hands of qualified specialists. Fostoria Industrial Service Centers, located in principal cities, are nationally recognized specialists in Industrial Lighting for Seeing. Their study and counsel on your lighting problems are available to you without obligation.



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Explains the efficient and economical results of "Balanced Lighting" and how to obtain it. Ask for BL-3-EC

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GENERALITES for Overall Lighting • LOCALITES for Light ON the Job

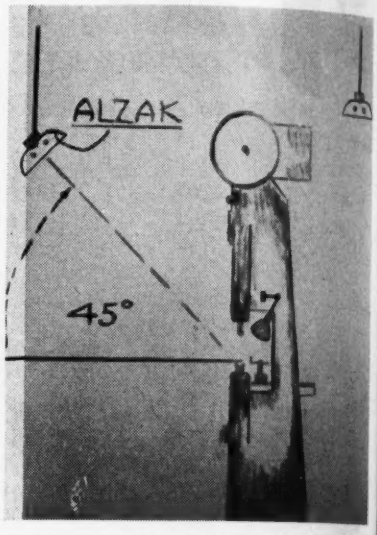
Trade Mark Reg. U. S. Pat. Off.

FOSTORIA INDUSTRIAL SERVICE

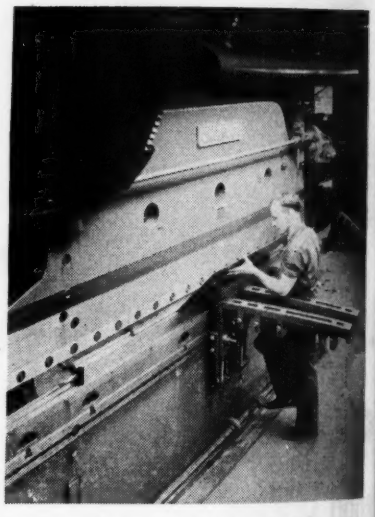
Factory and General Offices FOSTORIA, OHIO

In Canada—Write Amalgamated Electric Corp., Ltd., Toronto

cannot be illuminated by a small source near one or both ends because the thickness of the stock casts a shadow at exactly the point where the scale must be read. Recommended lighting for such scales is the installation of an elongated light source of low brightness parallel to the scale. A 40-watt fluorescent RLM unit will satisfy the requirements.



FRONT AND BACK lighting are a requisite for efficient power brake operation. These 200-watt fluorescent RLM units are located so they will clear stock when folded. General illumination of 35 foot-candles is recommended.

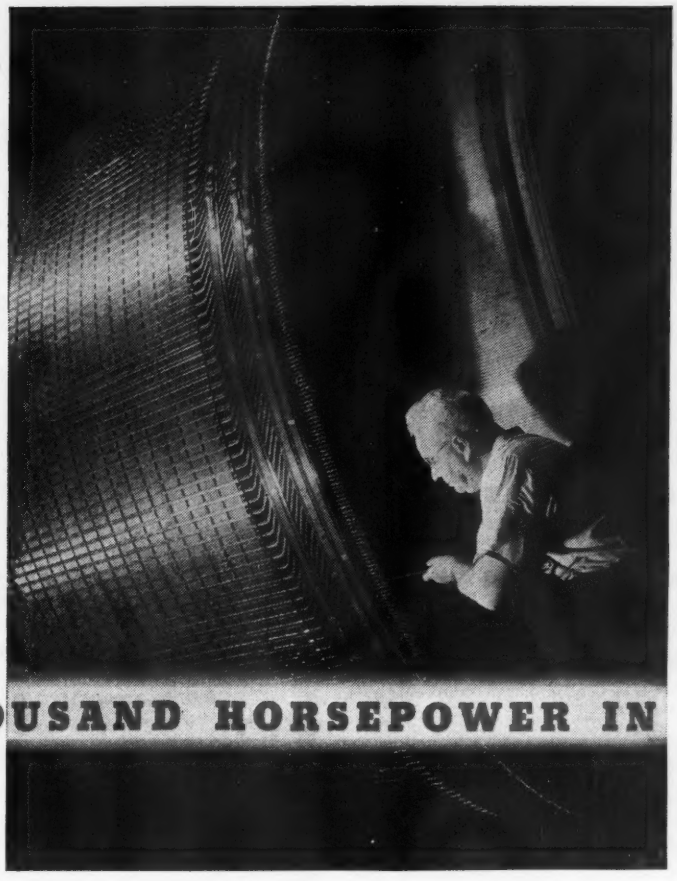


LOCALIZED LIGHTING provides over 100 foot-candles on working surfaces of this brake. The two-lamp, 40-watt fluorescent unit supplements an incandescent overhead lighting system.

Hand Brake—The lighting source for the sheet metal hand brake or folding machine should be located to the front of the shoe-type machine. Otherwise, the nose of the shoe casts a shadow making it extremely difficult to set scribed lines or punch marks.

The location of the brake with respect to overhead lighting depends upon the type of stock—cold rolled or

[Continued on page 169]



SEVEN THOUSAND HORSEPOWER IN ONE MOTOR

To drive a mill that rolls 120-inch steel plate, up to 2 inches in thickness, takes a motor with plenty of "guts".

This one has it. The rotor alone weighs 100 tons, whirls at a speed of more than 80 times a minute. More than 50,000 feet of copper wire are contained in its windings.

This 7,000 hp giant, one of the largest motors built by Westinghouse for the steel industry, is now helping to turn out armor plate for America's fighting forces.

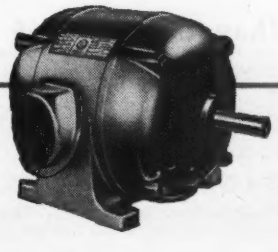
The chances are you'll never need a motor like this. Yet the kind of engineering skill that goes into such specialized motor jobs is back of every Westinghouse motor you buy—special or standard.

Whether you need a fractional horsepower motor or one delivering thousands of horsepower, Westinghouse experience can help you solve your drive problem quickly—with a motor exactly fitted to the job. Westinghouse Electric & Mfg. Co., East Pittsburgh, Penna.

J-21301

Westinghouse motors

PLANTS IN 25 CITIES... OFFICES EVERYWHERE



This is only one of the many Westinghouse general purpose motors available in standard and special enclosures. Features include choice of sealed-sleeve or ball bearings; Tuffernell insulation; dynamically balanced rotor; rigid one-piece frame; die-cast rotor; radio-frequency tested insulation.

Check these 5 Ways You Can Use *Benjamin Industrial Signals* to Increase Operating Efficiency in Your Plant

1. EXECUTIVE PAGING
For saving time in locating executives, foremen and key personnel who must move about the plant.

2. TELEPHONE EXTENSIONS
For making telephones instantly heard in noisy locations by replacing ringer bells with horns.

3. FIRE, BURGLAR ALARMS
For calling firemen or plant guards in an emergency and directing them to the scene of trouble.

4. MACHINERY ALARMS
For warning of overloads, interrupted coolant flow, broken webbs, etc., to prevent machine stoppages.

5. BREAKDOWN WARNINGS
For warning of water-tank level, boiler and air line pressure, etc., to prevent plant-services breakdown.

Benjamin MOTOR-DRIVEN HORN (Weatherproof)
Benjamin DOUBLE PROJECTOR HORN (Weatherproof)
Benjamin FIRE ALARM HOWLER (Weatherproof)
Benjamin FACTORY HOWLER (Non-Weatherproof)
Benjamin INDUSTRIAL SIREN (Coding—Non-Coding)
Benjamin TELECODE RELAY
Benjamin INDUSTRIAL BUZZERS

Now, when time is precious and manpower must be conserved, you can least afford the delays and confusion caused by a signal system which has failed to grow with your needs.

Your changed conditions of war-time operation . . . expanded floor space, re-arrangement of departments or new machine installations . . . undoubtedly have created many instances where improvements or extensions are vitally needed in your signal system to insure peak efficiency in every department of your plant.

What Improvement or Extension is Needed Most to Bring Your Signal System Up-to-Date?

Now is the time to make a thorough check of your signal system to see where new and more powerful signals are needed to replace those made inaudible by noisier conditions. Look, particularly, for those locations where your present signal system needs to be extended to provide adequate coverage to areas which have been added to your work space.

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When you call on Benjamin, you secure recommendations based on more than 30 years' experience in solving the signal problems of industry. Benjamin horns, buzzers, sirens and relays are built to the most rigid requirements of industrial service, have the extra margin of stamina for long, trouble-free operation. There is a Benjamin signal with exactly the right power and tone for every industrial location . . . let our engineers show you where these signals can be most useful to you in conserving time and labor.

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For more than 10 years, Benjamin has been building special horns and buzzers for the fleet, equipment which meets the Navy's rigid specifications for battle duty.

For further data or recommendations, write the Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Ill.

Benjamin Signals are Listed by the Underwriters' Laboratories. They are available for A.C or D.C. operation, in a wide range of voltages and cycles. Many can be had with choice of Double or Single Projectors.

A feature of Benjamin Vibrating Horns and Buzzers is the ease of servicing due to their unique construction which permits removal of the entire operating mechanism without touching the wiring.

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Fractional Horsepower Motor Selection

Characteristics, applications and control of the more popular types of small motors with application test data to determine motor ratings.

FRACTIONAL horsepower motors have an extremely wide range of application spanning the entire residential, commercial and industrial field. One important reason for the development of such a wide variety of small single-phase motors is the fact that generally speaking, only single phase power is available in residential and most commercial establishments. Standard stock motors are available to meet almost any operating requirement but where unusual conditions warrant, a motor of special design can be obtained. From the standpoint of economy and convenience, it is always advisable to use a standard motor if at all possible.

The accompanying chart covers the most popular types of fractional horsepower motors. Schematic diagrams, speed-torque curves, horsepower and speed limitations and other characteristics are given. Also approximate comparative prices are shown along with general remarks and typical applications.

Standard motors are generally designed to operate in ambient temperatures ranging between 10 and 40 deg. C. Line voltage variations of plus or minus 10 percent and frequency variations of plus or minus 5 percent are allowable. The motors are built for across-the-line starting.

The standard direction of rotation of fractional horsepower motors is counter-clockwise facing the end opposite the shaft extension.

Since the brushes of small d.c. and universal motors are often set off neutral, reverse operation is unsatisfactory. Single phase motors using a starting switch cannot ordinarily be reversed while running, since the starting winding (which determines direction) is then open-circuited. Special relays can overcome this if necessary, however.

Many fractionals are used for built-in, direct-connected operation. They can be used for external direct connection or any other type of drive such as gear, belt, chain, friction or hydraulic. Fractional gear-motors are also available for obtaining practically any output speed desired.

Another important mechanical consideration is mounting. Most fractionals can be obtained with an elastic or spring mounting arrangement which provides quiet operation.

Not all fractional horsepower motors are adaptable to speed control. How-

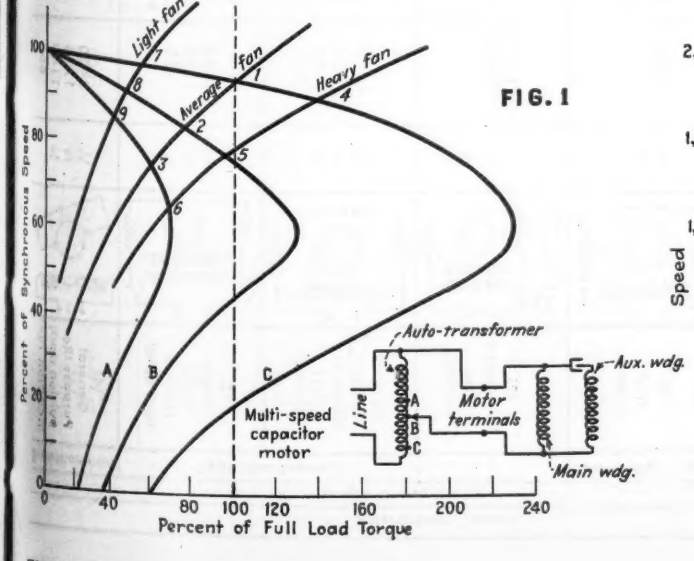


FIG. 1

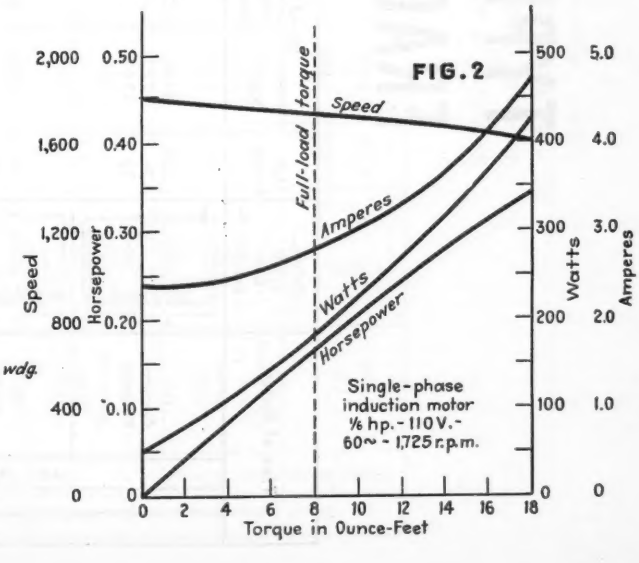
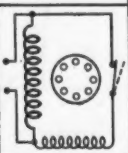
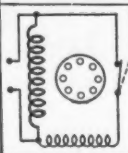
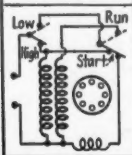
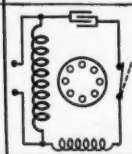
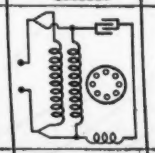
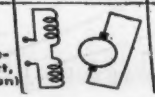


FIG. 2

TYPES and CHARACTERISTICS of FRACTIONAL HORSEPOWER MOTORS

Type of Motor			Schematic Diagrams	H.P. Range	Speed Data: Rated	Speed Data: Classification	Speed Data: Control	Torques: Starting	Torques: Breakdown	Built-in Automatic Starting Mechanism	Reversibility: At Rest	Reversibility: In Motion	Radio Interference	App. Comparative Prices %: Below 1/20 Hp.	App. Comparative Prices %: 1/20-1/4	App. Comparative Prices %: 1/3-3/4	General Remarks for Application Reference Data
Alternating Current	Single phase	Split-phase types	(1) General Purpose		1/20 to 1/3	3450 1725 1140 865	Constant	None	Med.	Med.	Centrifugal Switch	Yes Change Connections	No except with special design and relay	None	—	100	80	For applications up to 1/3 hp. where medium starting and breakdown torques are sufficient. Low starting current minimizes light flicker making motor very suitable for frequent starting, such as on oil burners, office appliances, fans and blowers.
			(2) High Torque		1/6 to 1/3	1725	Constant	None	High	High	Centrifugal Switch	Yes Change Connections	No except with special design and relay	None	—	75	54	Designed for continuous and intermittent duty applications where operation is infrequent and starting current in excess of NEMA values is not objectionable. Ideal for washing machines, ironers, sump pumps, and home workshop machines. May cause light flicker on underwired or overloaded lighting circuits.
		Capacitor types	(3) Two Speed (Two Winding)		1/8 to 3/4	1725/1140 1725/865	Two Speed	Two Speed Switch	Med.	Med.	Centrifugal Switch	Yes Change Connections	No	None	—	210	150	Used where two definite speeds independent of load are required. Rating above 1/4 hp. usually made capacitor-start. Motor shown always starts on high-speed connection; transfer to low speed made by starting switch. Common applications: belted blowers for warm-air furnaces or for other purposes; attic ventilators; air conditioning apparatus.
			(4) General Purpose (Capacitor start induction run)		1/8 to 3/4	3450 1725 1140 865	Constant	None	Very High	High	Centrifugal Switch	Yes Change Connections	No except with special design and relay	None	—	125	100	A general-purpose motor suitable for most applications requiring constant speed under varying loads, high starting and running torques, high overload capacity. Also available as two-speed two-winding motor above 1/4 hp. A few important applications are: refrigeration and air conditioning compressors; air compressors; stokers; gasoline pumps.
			(5) Single Value (Permanent split)		1/20 to 3/4	1620 1080 820	Constant or Adjustable Varying	Two speed switch or Autotransformer	Low	Med.	None	Yes Change Connections	Yes by plug reversing	None	—	140	100 to 110	For direct connected fan drives . . . particularly unit heaters. Not for belt drives. Same motor adaptable for 110 or 220 volts for 1-speed, 2-speed, or multi-speed service by use of 1-pole, single-throw switch; 2-pole, double-throw switch; or speed controller, respectively. Fan load must be accurately matched to motor output for proper speed control. All ratings dual voltage and dual rotation.
		Repulsion start	(6) General Purpose (Repulsion start, induction run)		1/8 to 3/4	3450 1725 1140 865	Constant	None	Very High	High	Short Circuiter	Yes Shift Rocker Ring	No	During Acceleration only	—	128	100	A constant-speed motor suited to general-purpose applications requiring high starting torque, such as pumps and compressors. An associated type, the repulsion induction (buried cage) is used for door openers and other plug-reversing applications.

Alternating Current	Single Phase	Repulsion	General Purpose (Repulsion start, Induction run)		⅛ to ¾	3450 1725 1140 865	Constant	None	Very High	High	Shaft Circuiter	Yes Shift Rocker Ring	No	Boring Acceleration only	—	120	100	Applications requiring high starting torque, such as refrigerator compressors. An associated type, the repulsion induction (buried cage) is used for door openers and other plug-reversing applications.
	Shaded Pole		(7) Shaded Pole		1/300 to 1/30	1500 1000	Constant or Adjustable Varying	Choke coil or Resistor	Low	Low	None	No	No	None	100	—	—	Where low outputs, low starting and running torques are sufficient, this constant-speed switchless type finds many uses. When used to drive a fan, speed control can be obtained by means of a series choke or resistor. Used for fans, unit heaters, small blowers, humidifiers, hair driers, and advertising displays.
	1, 2, or 3 phase	Non-excited synchronous	(8) Split Phase	See 1, 2, 3.	1/250 to ⅓	3600 1800 1200 900	Absolutely Constant	None	Low	Med.	Centrifugal Switch	See 1, 2, 3.	See 1, 2, 3.	None	—	200 to 400	275	Definitely constant speed. Principal applications are on instruments, sound recording and reproducing apparatus, teleprinters and facsimile printers. Type selected depends largely on starting torque. Squirrel-cage rotor has cut-outs, which result in synchronous speed characteristics. Stator may be wound for split-phase, capacitor-start, capacitor, or polyphase operation. Pull-in torque is affected by inertia of the connected load.
			(9) Capacitor Start	See 4.					Med.	Med.	Centrifugal Switch	See 4	See 4					
			(10) Single Value Capacitor	See 5.					Very Low	Med.	None	See 5	See 5					
			(11) Polyphase	See 12.					Med.	Med.	None	See 12	See 12					
	Polyphase	2 or 3 phase	(12) Squirrel Cage		1/6 to ¾	3450 1725 1140 865	Constant	None	Very High	Very High	None	Yes Change Connections	Yes by plug reversing	None	—	165 to 195	100	Companion motor to capacitor-start motor with comparable torques and generally suited to same applications if polyphase power is available. Inherently plug-reversible and suitable for door openers, hoists, etc. High-frequency motors used for high-speed applications, as for wood-working machinery, rayon spinning, and portable tools.
D.c. or A.c. (60 cycle or less)	Universal Types		(13) Without Governor		1/150 to 1	3000 to 11000	Varying or Adjustable Varying	Voltage Control Using Resistance or Transformer	Very High	—	None	No except with special design	No except with special design	Yes Continuous	75	105 to 175	—	Light weight for a given output, high speeds, varying-speed and universal characteristics make this type very popular for hand tools of all kinds, vacuum cleaners, etc. Ratings above ¼ hp. usually compensated. Some speed control can be effected by a resistor or by use of a tapped field. Used with reduction gear for slower speed applications.
			(14) With Governor		1/50 to 1/20	2000 to 4000	Adjustable Constant	Adjustable Governor	Very High	—	None	No except with special design	No except with special design	Yes Continuous	110	140 to 160	—	By means of a centrifugal governor, a constant-speed motor having the advantages of the universal motor is obtained. Governor may be single-speed or adjustable even while running. Speed is independent of applied voltage. Used in typewriters, calculating machines, food mixers, motion-picture cameras and projectors, etc.
Direct Current	Shunt, Compound and Series		(15) Shunt or Compound		1/20 to ¾	3450 1725 1140 865	Constant or Adjustable Varying	Armature Resistance	Very High	—	None	Yes Change Connections	No except with special design	Yes Continuous	—	175 to 225	120 to 140	A constant-speed companion motor for the capacitor-start or split-phase motor for use where only d-c power is available. For unit-heater service, armature resistance is used to obtain speed control. Not usually designed for field control.
			(16) Series		1/125 to 1/30	900 to 2000	Varying or Adjustable Varying	Resistance	Very High	—	None	Yes Change Connections	No except with special design	Yes Continuous	185	—	—	Principally used as the d-c companion to the shaded-pole motor for fan applications. Used in these small ratings in place of shunt motors to avoid using extremely small wire.

Selection of alternating or direct current fractional horsepower motors to fit load characteristics can be made quickly from this chart. By noting the characteristics of each type and comparing with the determining characteristics of the load the choice is readily limited to the one or two best adapted types. Approximate price comparisons are given for each size range in the last three columns of the table.

ever, where adjustable speed is essential, it may be obtained by adjusting the motor slip. The most adaptable motor for this type of speed control is the capacitor motor. A typical system for obtaining this control is shown in Fig. 1. It is to be remembered that the torque developed by the rotor varies as the square of the voltage applied to the motor windings. That is, if the terminal voltage is reduced to ½, then the developed torque is reduced to ¼. If it is reduced to ⅓, then the motor torque is reduced to 1/9. Or if the voltage is doubled, the torque is increased four times. Thus by using an auto transformer, the output torque and thus the speed can be varied over a limited range.

As a specific example refer to the curves of Fig. 1. Take the case of the average size fan. Its curve shows the torque required to drive it at various speeds. Curves A, B, and C represent the torques developed at the three settings of the auto transformer.

By setting the control point at C on the auto transformer and using the C curve, we see that it intersects the "average fan" curve at point 1, which means that the motor is developing 100 percent torque and the fan is operating at 94 percent synchronous speed.

If we reduce the applied voltage to point B, the motor output torque is as shown by curve B and where it intersects the "average fan" curve (at point 2) will be the operating point. That is, the motor, on reduced voltage is now developing only 76 percent of full load torque and the fan speed has been reduced to 83 percent of synchronous speed. Likewise at point 3, the motor is developing 60 percent torque resulting in a fan speed of 75 percent. The other two curves show what results are to be expected for a heavier than- and a lighter than-average fan.

Limitations

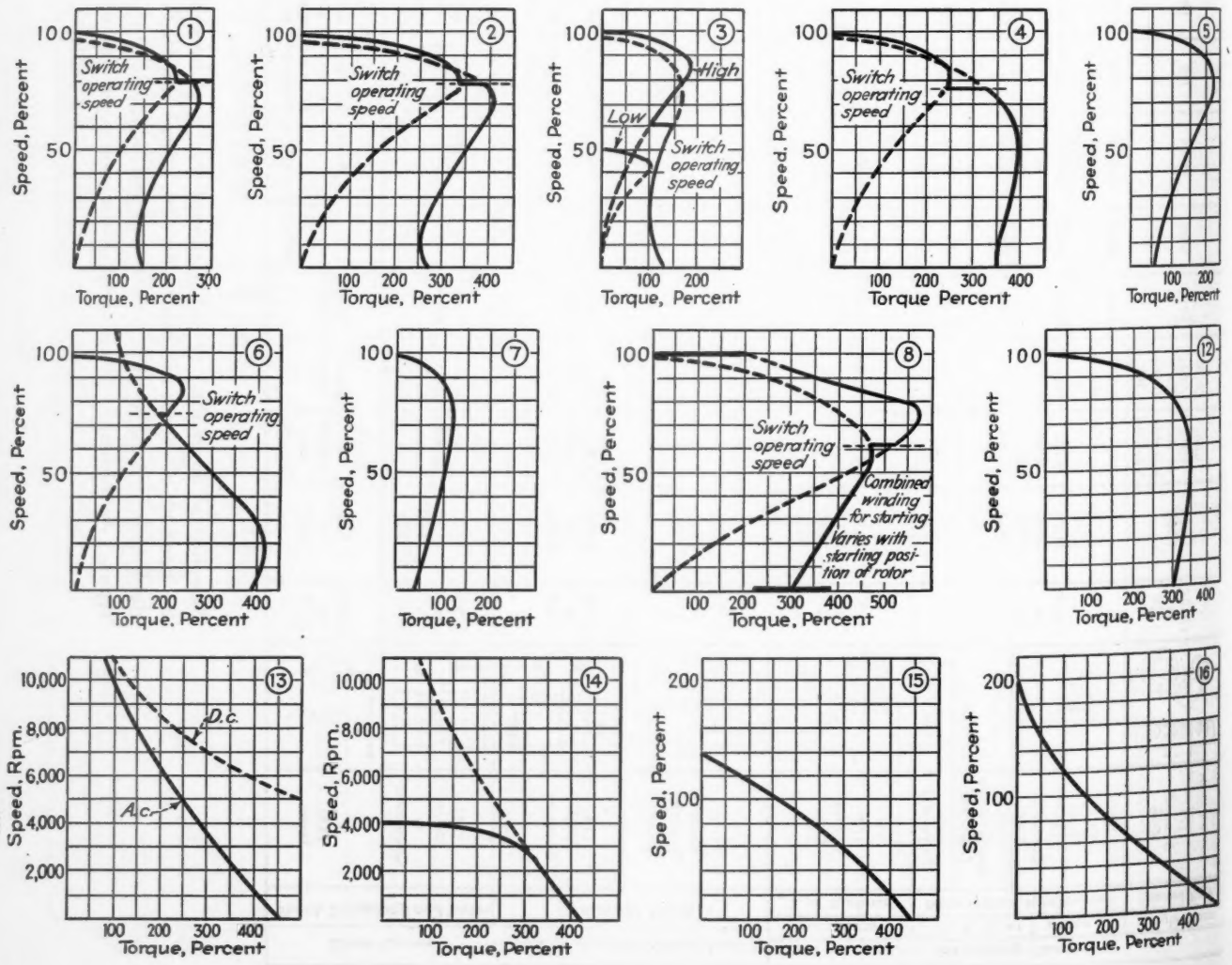
This type of control is not without its limitations. For one thing, note that for lighter loads, the speed range narrows to practically no variation at all regardless of the applied voltage changes. Starting torques on the lower voltage connections are also greatly reduced since the "torque to voltage squared" relation still holds for starting values as well as running values. Also, because of the low starting torque and the wide variations encountered in belt frictions, this type of speed control is not suited to belt drive applications.

Instability at the low speed connection is also a definite limitation. This characteristic of being unstable becomes more pronounced in motors having low slips at full load.

Tests

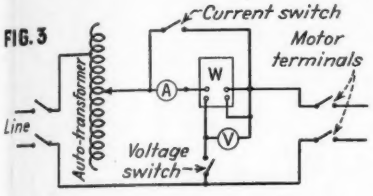
The curves of Fig. 2 are those taken from actual test and are shown as a warning against approximating horsepower requirements by direct ratio of current measurement to nameplate rating. Note that the current reads 2.8 amps. at the full load torque of 8 oz. ft. At half load (or 4 oz. ft. torque) the current measures 2.45 amps. Thus, reducing the motor load 50 percent only reduces motor current 12½ percent. It is seen that comparison of test current with nameplate current is no indication of motor load.

For true indications, brake tests should be made on each motor and data drawn up in curves such as Fig. 2, with the addition of efficiency and power factor curves.



The test connections of Fig. 3 should be used in making application tests for determining proper motor ratings and characteristics. Since the currents and watts being measured are so small, meter readings should be corrected for meter coil losses. Note that in Fig. 3 the voltage coils of the voltmeter and wattmeter are on the load side of the ammeter and the current coil of the wattmeter. Consequently, the losses in these two potential coils will be reflected in the current and wattage readings. By closing the

FIG. 3



line switch and voltage switch but leaving the motor terminal switch open, these meter losses can be read directly and subtracted from all test readings to give true indications.

To make an application test, select a motor of the type and rating thought to be approximately correct to meet requirements of the load. Run a brake test on the motor to obtain curves such as Fig. 2, or perhaps the manufacturer can supply them. Then connect the test motor to the load and run an application test to determine the torque requirements of the motor to meet the operating torques of the load and other data necessary for establishing the complete rating. Adjust the load to approximate the maximum operating conditions.

To find the various critical torques by using the auto transformer, determine:

1. The minimum voltage required to start the load in any position.
2. The minimum voltage required to bring the motor up to about half speed.
3. The minimum voltage required for the motor to pull-in from starting connection to running connection.
4. The minimum voltage at which motor will carry the load without an abrupt drop in speed.

These tests will determine respectively, starting, pull-up, pull-in and breakdown torques. If these torque values are known for the test motor at *rated voltage,* the four voltage readings above can be interpreted into torque readings by calculation on the assumption that the torques vary as the square of the voltage.

For example, suppose a 1/6 hp. split-phase, 1725 rpm, 60 cycle test motor is used and test data show it to have a 19 ounce-feet breakdown torque at rated voltage of 110 volts. Test No. 4 of application test above shows that 80 volts are required to maintain the test motor at a stable operating speed for the maximum load encountered.

Thus since:

$$\frac{T_T}{T_R} = \frac{V_T^2}{V_R^2} \text{ or } T_T = T_R \times \frac{V_T^2}{V_R^2}$$

and

$T_R = 19$ oz. ft.
$V_R = 110$ volts
$V_T = 80$ volts

then

$$T_T = 19 \times \frac{80^2}{110^2} = 19 \times \frac{6400}{12100}$$
$$= 10 \text{ oz. ft.}$$

Thus maximum torque required by the load will be 10 oz. ft. Full load torque of any motor, in terms of rated horsepower and speed is

$$\text{full load torque in oz. ft.} = \frac{84000 \times hp.}{rpm}$$

Table above shows upper limits of current and watts input for 115 volt, 60 cycle general purpose motors based on NEMA performance standards. Table below shows NEMA established limits for locked-rotor currents except for split-phase high torque and synchronous types.

For a more complete treatment of the subject of fractional horsepower motors, consult "Fractional Horsepower Electric Motors" by Veinott, and Standard Handbook for Electrical Engineers, both published by the McGraw-Hill Book Company.

Rating hp.	Amperes at	
	115 volts	230 volts
1/6 and smaller	20	10
1/4	23	11½
1/3	31	15½
1/2	45	22½
3/4	61	30½

Horsepower rating	3450		1725 rpm		1140 rpm		865 rpm	
	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
1/8	2.89	207	2.70	176	3.86	207	5.40	245
1/6	3.18	254	3.00	215	4.32	254	6.00	296
1/4	4.16	352	3.86	301	5.60	352	8.11	414
1/3	5.27	460	4.91	395	6.98	460	9.85	540
1/2	7.37	678	6.90	574	9.85	678		
3/4	10.6	980	9.95	834				

MULTIPLE UNIT plugs and receptacles

3 unit sectional view.

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Any combination, 2 to 32 poles, for thermo-couples, sound equipment, remote controls, lighting and motor wiring. Interchangeable contact units—1 to 8 poles—can be assembled in 2, 3, or 4 unit plug shells and receptacle housings to make any desired combination of circuits. Equipment can be arranged with the protected female contact units in either plug or receptacle, for safety in line side of the circuit. Ground protection is provided. A full line of plug shells, cable connectors, and standard receptacles allows the widest range of assembly combinations, to meet any needs. Write for general catalog 1100 giving complete specifications.

THE PYLE-NATIONAL COMPANY
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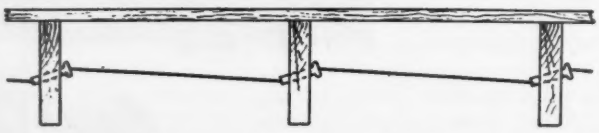
DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

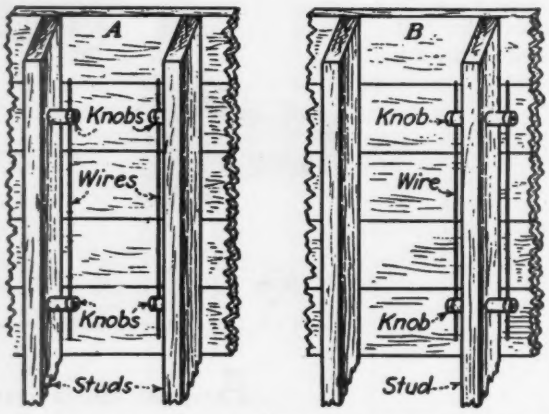
W-2

Knob and Tube Work

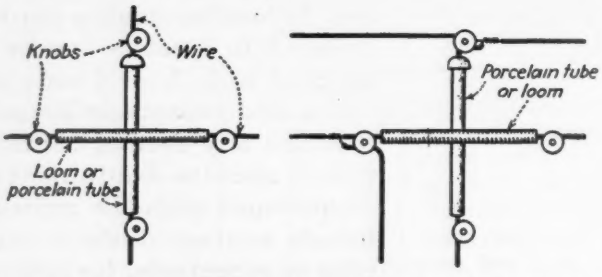
A pictorial presentation of knob and tube methods. The critical material situation has resulted in widespread use of this type of wiring.



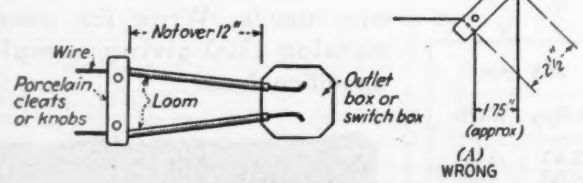
1 To prevent tubes from falling out of the holes, they should be bored through the timbers at an angle.



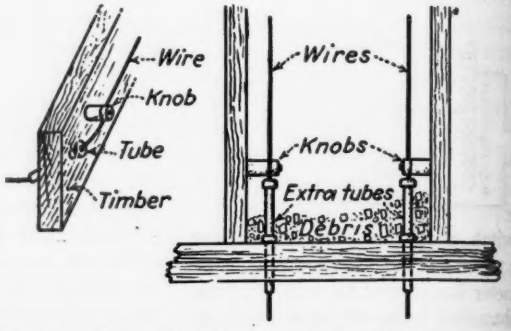
2 Vertical wires within a wall can be run on either side of the same stud or on the facing sides of two adjacent studs.



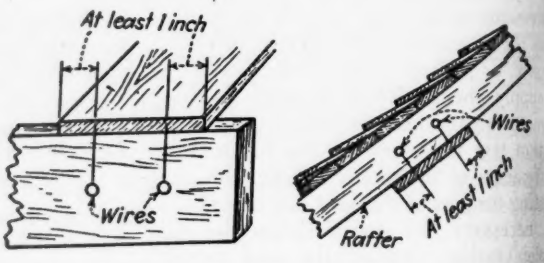
3 Additional protection should be given to crossing wires by loom and porcelain tubes. Tap points are similarly protected. Also protect if wires come within 2 inches of pipe or other metal work.



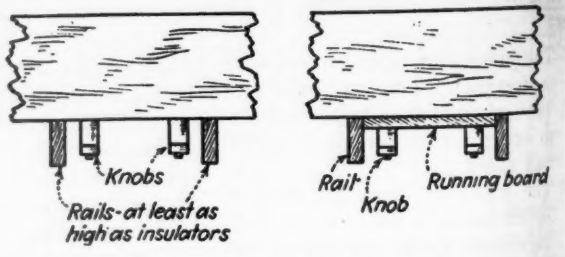
4 Cleats can be used for straight runs, terminating at outlet box in exposed wiring. However, they cannot be used, in any case for making a right-angle turn because of the reduction in spacing.



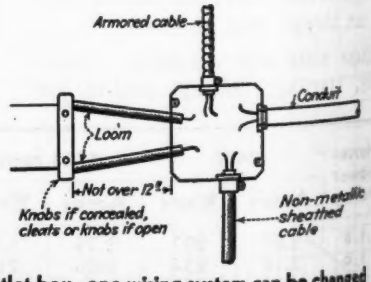
5 Use a knob near the tube at angle take-off points. Use extra tubes at points where debris may collect such as where a wire passes through the floor timber.



6 Wires exposed to mechanical injury should be protected by running boards.



7 Rails may be used for protection against mechanical injury, or both rails and running boards can be used.



8 By means of an outlet box, one wiring system can be changed to another. Here are conduit, armored cable, knob and tube, and non-metallic sheathed cable terminating in the same box.

Information from Practical Electrical Wiring by Richter. Copyright McGraw-Hill Book Company

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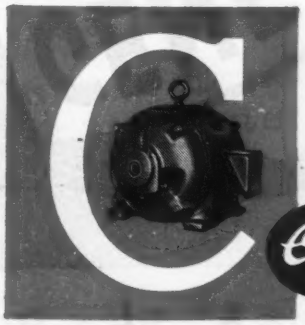

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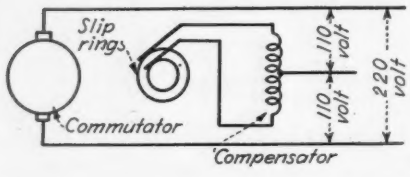
READER'S QUIZ

CHANGING GENERATOR

QUESTION 126. We have a 15 kw. 110 volt, d.c. compound wound generator driven at 400 r.p.m. We wish to supply a d.c., 3-wire combination power and light load 110–220 volt. What changes would have to be made to this generator in order for it to deliver its rated output at the present speed and the desired voltage?—G. E.

A. TO QUESTION 126. The changes necessary to make a 110/220 volt three-wire generator from a 110 volt d.c. compound generator would be rather involved. It would be necessary to rewind or reconnect the field windings to take care of the increased voltage, also the armature must be rewound for 220 volts and provided with two slip rings connected to the



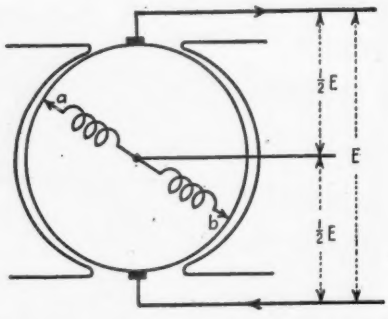
winding and to a "compensator" or coil which is tapped at its mid-point to provide a neutral point. With the armature in any definite position connect a lead from the commutator segment under each positive brush to one slip ring and from the segment under each negative brush to the other slip ring.

Brushes must be provided to contact the slip rings and a "compensator" or coil must be connected between the brushes. The size will depend upon the probable unbalance. The connections of the armature and compensator would be as shown.

This seems a complicated change and it might be better to attempt to secure a 3-wire generator by trade or to use all 110-volt equipment. If your distances are not too great this might be best.

The changes will as indicated involve rewinding or at least reconnecting of field windings, rewinding of armature, adding of two slip rings with brushes and brush rigging and the providing of the compensator and proper connections.—J.E.W.

A. TO QUESTION 126. In order to change the machine to a three-wire generator, it will be necessary to connect a coil of high reactance and low resistance permanently across diametrically opposite points on the armature as shown in the diagram.



The voltage between points "a" and "b" is alternating. The alternating current flow in the coil is small because of the high reactance. The center of the coil is connected to the neutral of the system. On unbalanced load, the difference between the currents in the outside wires flows in the neutral wire and through the reactance coil, which has a low resistance to direct current. For 25 percent unbalanced current, the rating of the balance coil in volt-amperes would be about 10 percent of that of the generator. Changing the machine from a two wire to a three wire machine, is a job for the manufacturer or some good motor and generator shop.—V.M.

A. TO QUESTION 126. I would suggest limiting the changes involved to a minimum. If the rated output of the generator is to remain the same at twice the rated voltage the first item to consider is the armature. Most low voltage armatures are lap-wound and the possibility of reconnecting should be investigated. Consequently, if features of construction permit, a wave connection may be made. In extreme cases it will be found advisable to rewind the armature with possibly twice the number of effective armature conductors between brushes of opposite polarity. Magnetization and external characteristic curves should be made before changing the armature, for future reference.

When the armature has been changed, assemble the machine and run a magnetization curve again. With the data compute the changes which may have to be made to the fields. Insert a proper variable resistor in the field circuit and run an external characteristic curve. The data will now furnish information regarding changes, if any, to the fields.

Determine the approximate amount of unbalance in the proposed 3-wire system and obtain accordingly a small 110-volt balancer or compensating set from which the neutral may be established. This eliminates the construction of a.c. rings, brush rigging, etc.—O.A.

QUIET OPERATION OF MAGNETS

QUESTION 127. *We have been having trouble with noisy magnets, particularly on an old automatic three phase, 60 cycle compensator, which is noisy on the running side. Everything seems tight, and the armature seems to line up with the cores of the magnetic coils. Perhaps some one can give some general pointers on the quiet operation of magnets that might help us out. —J.H.G.*

A. TO QUESTION 127. When the hum on a.c. contactor magnets becomes excessive check to see if any of the following conditions exist:

(a) The voltage may be below the minimum rating of the operating coil. If the coil has ever been replaced make sure that the proper coil for the magnet has been installed.

(b) The spring pressure on the contacts may be too high. Guide washers

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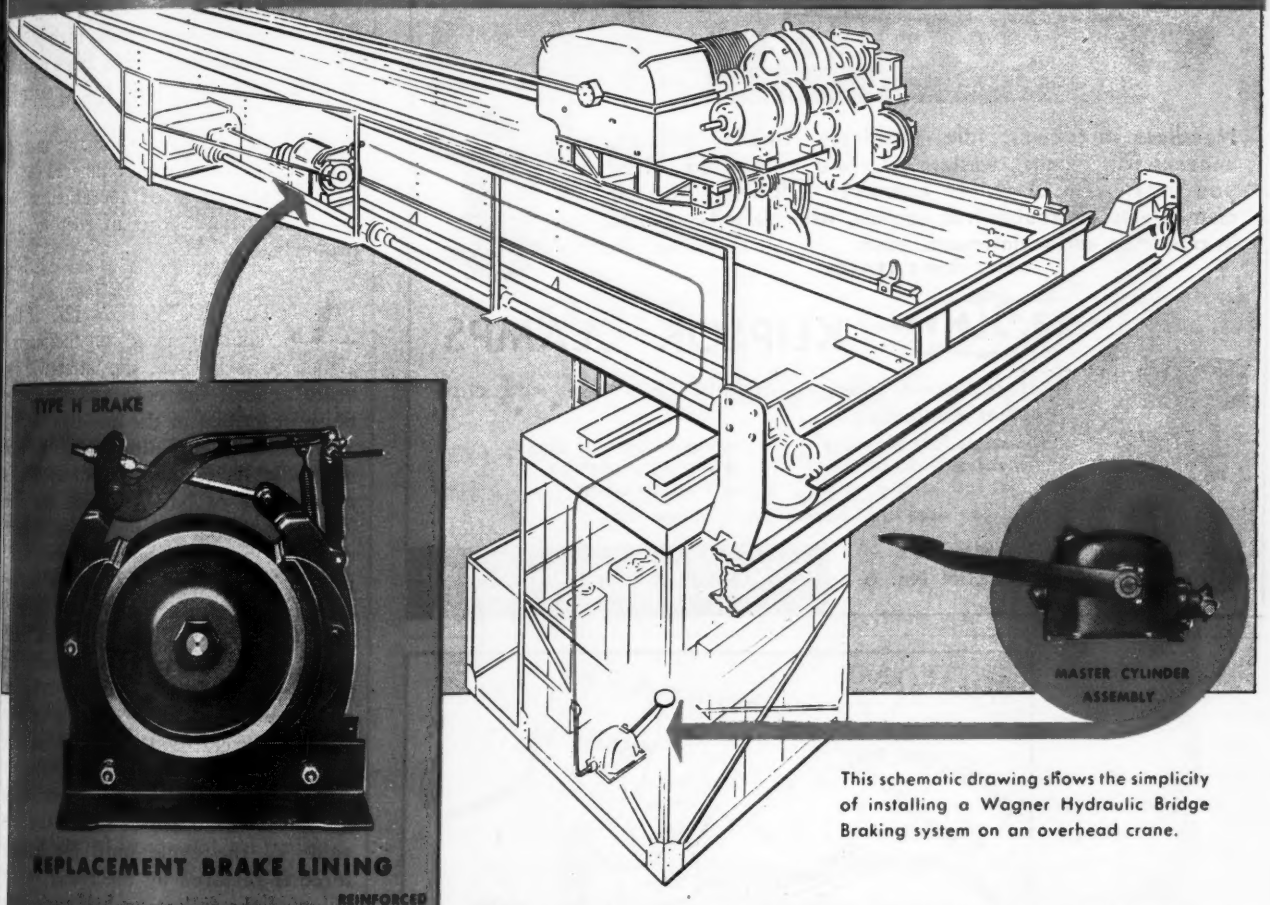
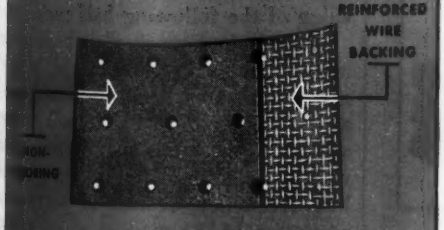


This schematic drawing shows the simplicity of installing a Wagner Hydraulic Bridge Braking system on an overhead crane.

REPLACEMENT BRAKE LINING



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WRITE FOR BULLETIN IU-20—It gives complete information on Wagner Hydraulic Bridge Braking Systems and Wagner Industrial Brake Lining. 144-4

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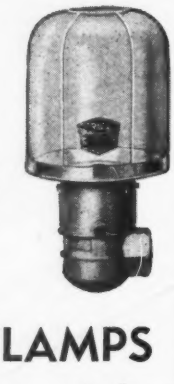

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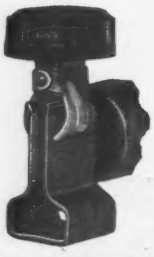

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and pins for the springs may be worn causing binding.

(c) The shading coil on the magnet may be broken. It should be welded or brazed together. Solder will not hold.

(d) The armature lever may be worn in the pivots or distorted through rough use. This will not allow the floating armature to find a square seat.

Check this by placing a sheet of paper between the two pole faces and close the magnet electrically, which will leave an impression on the high points. Contact should be over a large portion of the pole face, but full contact is not actually necessary.

(e) The pole face of the magnet may be corroded, or hammered out of shape from years of operation, which will not permit the magnet to seal properly.—L. H.

A. TO QUESTION 127. If the "shading ring" on the magnet armature is broken, the latter will vibrate against the core and set up the noise described in the question.

Armatures in alternating current magnetic starters are constructed with metal clips or bands around the end. These bands or "shading rings" form a short circuited single turn coil tending to hold the magnet closed during the zero voltage points of each cycle.

As the succeeding waves of each cycle die away, the lines of force cut across the short circuited "shading ring" and set up an opposing current which so retards the change of flux in the surrounding armature as to produce a weak magnetic force which holds the armature closed at the zero value of the cycle until the holding force is restored by the rising voltage value of the following half cycle.

If the "shading ring" is broken, the holding action is not exerted at the zero point and the armature drops away from the core. It will reclose with a slight jar as the current value rises. Repetition of this jar at twice line frequency, results in very noisy operation of the magnet which can be eliminated only by replacing or repairing the broken part.—E.F.W.

A. TO QUESTION 127. Noisy magnets may be caused by any of the following: (a) Dirt or rust on the magnet faces; (b) Poor contacts in the control circuit; (c) Low voltage; (d) Worn, loose, or broken parts; (e) Broken pole shader; (f) Overloaded magnet; (g) Magnet faces not true.

If the trouble is found to fall under a, b, c, or d, the remedy is obvious and very simple.

In the event it happens to fall under (e) (broken pole shader), the immediate requirement is that the pole

shader be replaced. However, in this case, further examination should be made in an effort to determine the cause. This condition is frequently caused by heavy slamming which in turn may be caused by overvoltage, the use of the wrong coil, or an underloaded magnet (an underloaded magnet is sometimes caused by subnormal contact pressure).

Trouble discussed under (f) an overloaded magnet may be caused by mechanical parts which bind or by improper adjustment such as too much pressure on contacts or length of travel of the various parts not properly coordinated.

Magnet faces that are not true (g) must, as a rule, be replaced. Before replacing, however, it would be advisable to ascertain if possible whether this was caused by normal wear or whether it was the result of some strain set up in the apparatus due to improper mounting.—D.L.G.

A. TO QUESTION 127. Noisy magnets, or magnets that cause a loud humming is a trouble that is found on the magnetic or holding coils of compensators and across-the-line magnetic starters.

The trouble can usually be eliminated by cleaning the surfaces of the pole faces and to examine the stationary pole piece on which is found a slot in the laminated surfaces and which contains a small coil, called a shading coil.

This coil often works loose in its slot or breaks and falls out and causes the magnet to hum very loudly. If a new shading coil is installed or if the old one is not broken and can be securely tightened in its slot the trouble will be eliminated.—T.R.

CONVERTING MOTOR INTO AN ARC WELDER

QUESTION 128. I have a 60 volt d.c. compound-wound motor which I desire to convert into an arc welder. In using two six-volt storage batteries in series (12 volts) as an exciter across the fields, I find that I can melt fairly large rods. But in using a ½ hp. 125 volt d.c. motor with an output of four amps., I get only light sparks on the welding rods. In order to use this small motor as an exciter, what shall I do to the motor I'm using as a welding generator? If your answer involves rewinding of the fields, etc. give a formula for computing the number of turns, size of wire, etc.—D.A.

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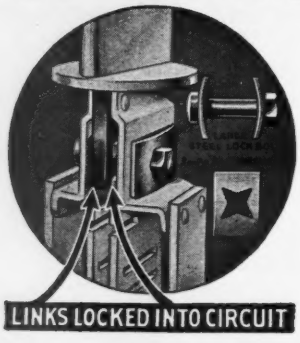

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A. TO QUESTION 128. You will have to rewind the field of the welding generator in order to use the small motor as an exciter.

If the two six-volt batteries give sufficient excitation, then measure the ampere flow in the field with the batteries connected. Then strip off the old field and count the turns. Multiply the number of turns by the ampere flow for your ampere turns in your old field. Amperes turns = amperes × turns.

Divide your ampere-turns necessary by the 4 ampere output of your exciter for the number of turns you will have to wind back for your field. Turns = amperes turns ÷ amperes.

To determine the wire size find the resistance necessary by the formula R = E/I. Calculate the approximate length of wire in your field coil by multiplying the length of one turn by the number of turns. Divide the approximate length by 1000 and divide your resistance by this answer. Then check this answer with a corresponding number on a magnet wire table under the heading of ohms per 1000 ft. Read the wire size directly opposite this number.—F.F.

A. TO QUESTION 128. In order to solve this problem we should know more about the motor which is to be used as an arc welding generator. If we had the value of the field current and the number of poles we could decide whether we could change connections or whether the field must be rewound. Apparently the 12 volt batteries supplied enough field strength to raise the terminal voltage to a value to sustain the arc. Since the exciter delivers only four amperes we must have the field coils reconnected or rewound to give at least the ampere turns secured with the 12 volt battery connection.

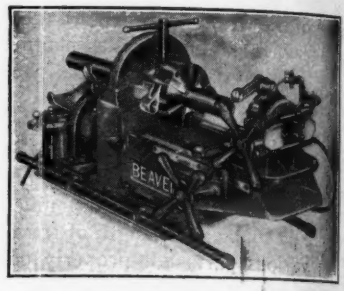
If we assume 16 amperes field current and four poles or four sections of the field winding, it might be possible to reconnect the fields and get sufficient field strength. If this is not possible it will be necessary to rewind so that the product of the available current (4 ampere) and the number of turns is equal to the product of the present required field current and present number of turns.—J.E.W.

A. TO QUESTION 128. If he does not get enough excitation with 4 amps, it may not be practical to rewind his motor—but he could get a second hand, 12 volt car or truck generator that would supply any current up to 30 amperes which would be more than enough.

This would be cheaper and far more practical.—J.R.W.

The A-B-C of . . .

Pipe and Bolt Machines!



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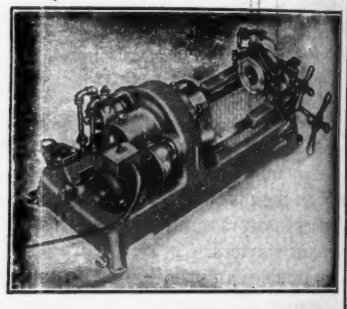
A high-speed heavy-duty deluxe Pipe and Bolt Machine. Range ⅛ to 2-inch-up to 12-inch with geared tools and drive shaft. Bolts, ¼ to 2-inch. Wt. 415 lbs.

Write for Bulletin A



Beaver Model-B

A light-weight utility Pipe and Bolt Machine combining many features of Model-A with the easy portability of Model-C. Range ⅛ to 2-inch up to 8-inch with drive shaft and geared tools. Bolts up to 1½-inch. Weight 280 lbs.

Write for Bulletin B

Beaver Model-C

A STURDY LITTLE POWER UNIT Converts hand pipe tools into power tools from ¼ to 8-inch. Threads 8-inch in 6 minutes. Threads bolts up to 1½-inch. Two men can work at the same time without interference. Weight 150 lbs.

Write for Bulletin C

Write for new Tool and Machine Catalogue—Just off the press

BEAVER PIPE TOOLS

342 Deen Ave. Warren, O.

Can you ANSWER these QUESTIONS

QUESTION D5.—I have a number of switchboard ammeters which were connected to 40 to 1 current transformers. These transformers have been changed to 60 to 1, and the meters do not give me a correct reading. Can someone tell me how to overcome this and make the meters read correctly?—R.M.

QUESTION E5.—We recently opened for inspection and cleaning a 50 hp., 1750 rpm, totally enclosed, squirrel cage induction motor and found the end ring on both ends of the rotor broken into several pieces. We have been unable to determine the cause of the end ring breakage. The motor was operating up to the time it was torn down for inspection so we are unable to tell how long the rings have been broken. If anyone has had a similar experience we would appreciate having his ideas on the cause of such breakage. –R.C.M.

QUESTION F5.—We have a bucket elevator driving an induction motor and a V-belt drive. This elevator blocks at times caused by buckets catching or some other cause and each time this happens the V-belts are burnt up. The motor is 15 hp., 550 volt, 3 phase, 25 cycle with across-the-line automatic starter. Could someone suggest a suitable switch that would cut the motor off, as soon as the elevator blocks and save the V-belts?—W.R.T.

QUESTION G5.—If a motor were checked and one found the resistance of the insulation to be slightly lower than the recommended minimum, what should be done? Should it be rewound?—F.F.

QUESTION H5.—Since we increased the size of the lift magnet on one of our cranes it is very difficult to control the lowering operation owing to the increased weight. On lowering, the motor runs faster on the first step than when the controller is full on. The hoist motor is a 3 phase, 440-volt, 60 cycle, slip ring type with a drum controller. Is there some way to check the speed of this motor similar to the dynamic braking used on d.c. motors? The hoisting operation works satisfactorily.—J.J.L.

QUESTION J5.—I have a 75 hp., 440 volt, 3 phase, 60 cycle motor that has just been rewound and reconnected to run 514 rpm instead of 600 rpm, its original speed. As yet we have not put the load on it but have been running it idle. It seems to run all right and the speed is 516 rpm, but it has a noise in it I never heard before. The regular a.c. hum is there and is constant, but there is another sing to it that tends to build up in volume and stop with a loud "thump", that

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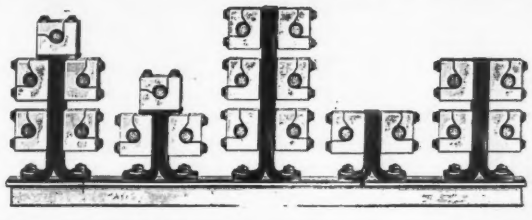

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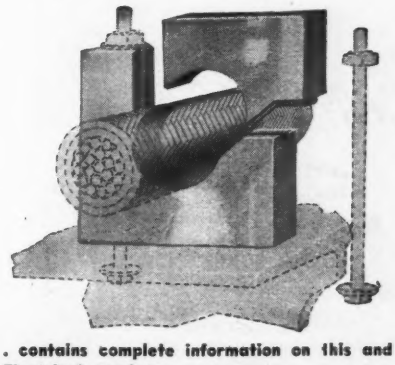
● Simple . . . rigid . . . strong . . . features that have made EFFICIENCY Nested Cleat Racks the choice for efficient conductor mounting. The "nested" design permits cable suspension in a minimum space and at the same time speeds installation. A further aid to mounting convenience is the EFFICIENCY Time Saver Cleat, designed for use in conjunction with Nested Cleat Racks. Note, in the illustration, that the cleat is mounted permanently with one bolt, thus forming a solid support for the wire or cable. With this design the cable may be left to hang slack, or be drawn taut at the time of suspension. Using these units in combination *one man can install cable faster than two men with the usual type of cleats and racks.*



WRITE TODAY for our Catalog No. 38A . . . contains complete information on this and other EFFICIENCY Electrical Devices

Efficiency ELECTRIC AND MANUFACTURING CO.
MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION

jars the motor and the timbers it sets on. This thumping is intermittent, occurring once or twice a second or once or twice a minute. The air gap is uniform and there is $\frac{3}{16}$-in. end play, but the rotor does not move end ways when the noise occurs. It has ball bearings and seems to be in good shape.—J.F.

QUESTION K5.—We have a 30 hp. 230 volt d.c. compound wound motor, amperes 110, rpm 1100. I would like to convert this motor over to a generator. Can a reader suggest the necessary changes which will do this?—R.E.P.

QUESTION L5.—How do you check the condition of all parts of a sealed circuit breaker? I am sure that they cannot stand an unlimited number of openings at their peak ratings.—H.S.

QUESTION M5.—We have five 440-volt 3-phase motors, each drawing unbalanced currents. The high or low values do not occur in the same phases in each case. The following readings were obtained:

75-hp.	58,	41,	54	amperes
35-hp.	36,	22,	24	amperes
35-hp.	23,	16,	22	amperes
20-hp.	13,	8,	12	amperes
7½-hp.	3.7,	4.1,	6.6	amperes

Regarding voltage, the regulation is good and the phases are maintained at about 470, 465 and 480 volts. The transformer bank consists of three apparently identical units, connected primary wye with neutral point isolated from common neutral and ground, secondary delta.

What might be the cause of these unbalanced current readings?—J.M.T.

QUESTION N5. I would like to hear from readers who have had experience in the testing of cable insulation, both single and 3 conductor and with various types of insulation, such as lead sheath, paper insulated; types "R", "RA", and "RP" rubber; also VC insulated conductors.

I am especially interested in Megger readings on the above mentioned types of wire and cables at various temperatures, and would like to have recommendations as to just what is considered a satisfactory reading at specific temperatures on runs in conduit and underground cables.—R.L.M.

QUESTION P5. Can someone tell me how to select the proper type and size of condenser to be used to reduce arcing of relay contacts controlling d.c. inductive loads, such as small motors, electric brakes, solenoids, etc., on 110 and 220 volts d.c.? What condenser for bells and signals on a 6-12 volt battery system?—H.R.S.

PLEASE SEND IN YOUR ANSWER BY APRIL 1

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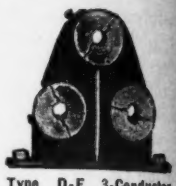
New NON-INDUCTIVE CABLE RACK
for INDUSTRIAL PLANT WIRING



Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2⅜".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushings.

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CONDUIT CLAMP
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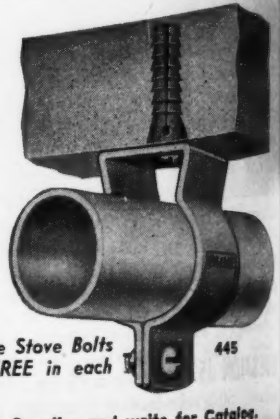

Correct size Stove Bolts furnished FREE in each clamp. 445

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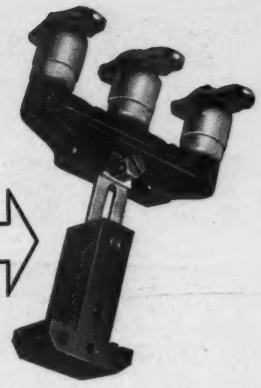
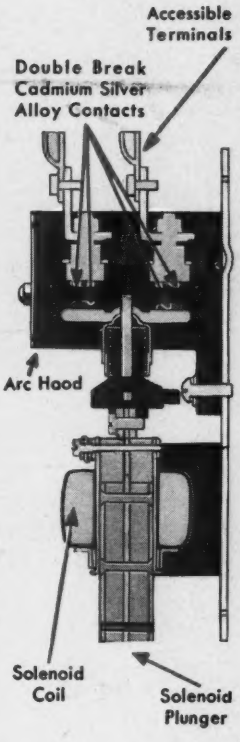
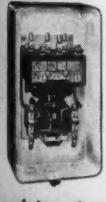
THERE'S ONLY ONE MOVING PART

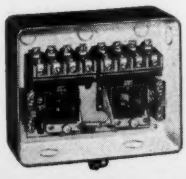


Solenoid Plunger operates double break contacts with straight up-and-down motion.



Arc hood enclosing the contacts provides unusually compact construction with plenty of wiring space at top, bottom, sides. A-B solenoid starters will interrupt at least ten times the maximum horsepower rating of the starter. Write for "The Story of the Solenoid Starter."


Automatic


Reversing

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Combination

Allen-Bradley solenoid starters are trouble-free because they are so simple. The double break, silver alloy contacts require no maintenance. There are no pins, pivots, bearings, hinges, or flexible jumpers to gum up, stick, or corrode. They are good for millions of trouble-free operations. Send for Bulletin 709 today.

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The general-purpose enclosure, specified for most installations, is sheet steel . . . "bonderized" . . . to provide a rust-resisting undercoat for the baked enamel finish. The adhesion and durability of the enamel surface is tremendously increased. Infra-red lamp ovens are used for hardening the enamel top coat.

Enclosures for special applications are made of cast iron or sheet steel, depending upon the hazard encountered. Live rubber gaskets, machined fit between cover and base, wide machined flanges, or bolted covers provide full protection under various service conditions.

The two models for wall or pedestal mounting were designed specially for machine tool applications. They help improve the appearance of machine tools by making streamlining possible.

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A-B Quality

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SOLENOID MOTOR CONTROL

QUALITY

Answered by
F. N. M. SQUIRES
Chief Inspector New York Board of Fire Underwriters

QUESTIONS ON THE CODE

"T" RATED SWITCHES

Q. (1) *"In a given case, if two equal snap switches are placed on a table, one of which was of the 'T' type, but unstamped, how would it be determined which was the 'T' rated switch?"*—E.H.

A. (1) If a switch is not stamped with a "T" it would not be recognized as a "T" rated switch and would be credited with having only the rating of an ordinary switch.

Q. (2) *"Can a 'T' rated switch be used on non-inductive loads and on non-gas filled lamps for a value higher than the stamped capacity? If so, how much higher?"*

A. (2) No. The fact that a switch is "T" rated does not give it a higher ampere capacity. It is generally, however, a better constructed switch than one which is not "T" rated.

Q. (3) *"In amendment No. 57, section 3814-b, it is stated that 'T' rated switches, with exceptions as noted below in 3814-b and b1, shall be used on circuits having tungsten-filament lamps and non-inductive loads.*
"What type of switch should be used on a circuit having tungsten-filament lamps and inductive loads?"

A. (3) For such a circuit the switch should be "T" rated in order to take care of the inrush current of the tungsten-filament load and the capacity rating of the switch should be twice the amperage of the inductive load plus the amperage to the tungsten load.

Q. (4) *"It is stated in 3814-b and b1 of Amendment No. 57 that 'T' rated switches shall be used on circuits having tungsten-filament lamps and non-inductive loads except in private homes, in multiple occupancy dwellings used only as living quarters, in private hospitals or hotel rooms, etc.*
"If the use of type 'T' switches minimizes the hazards to life and property, why should any exceptions be made?"

A. (4) The modification of the rule in favor of the dwelling occupancies mentioned is because the ampere loads on the switches in such locations are usually quite small and not much trouble has been experienced there. The difficulties which resulted in the requirements in the Code were experienced with larger loads than is found in the average home.

Q. (5) *"It is stated in 3814-c that switches controlling inductive loads shall have an ampere rating of twice the load. Does this statement apply to both the 'T' rated and the ordinary switch?"*

A. (5) Yes. A switch controlling an inductive load with or without other load should have a carrying capacity of twice the inductive load (plus any other load) whether "T" rated or not.

DOUBLE POLE SWITCH

Q. *"Is it necessary to have a double break toggle switch, that is, one that breaks the live and ground wires to a chicken coop that has one 60 watt lamp? This particular light is controlled from the house."*—M.Z.

A. The only place in which the Code now requires that a switch break both the live and the grounded conductors of a circuit is a circuit running into a film-storage vault as required by section 5307.

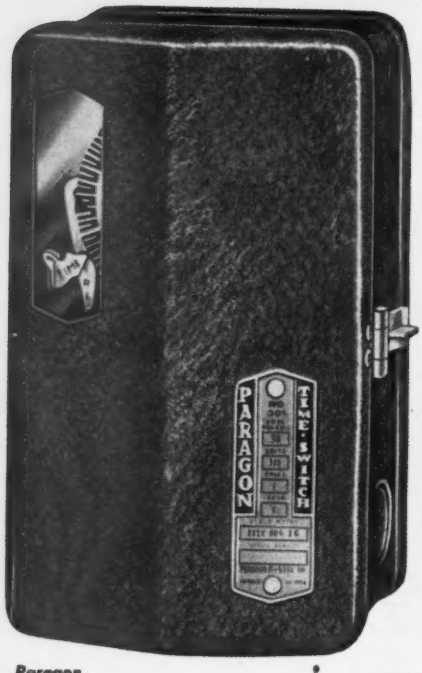
It would be advisable, however, to follow the requirements on fusing as set down in rule 2409b, and to provide a double pole switch in circuits which, because of the likelihood of reversal of connections, are required by the authority having jurisdiction, to provide double pole fusing.

The answer to the question therefore is that a double pole switch is not required, provided one circuit conductor is a grounded one.

INTERRUPTING CAPACITIES OF BREAKERS

Q. *"Does the Code have any rules covering the required interrupting capacity of circuit breakers when used for service entrance switches or for motor feeder and*

BLOCK ELECTRIC COMPANY turned out en masse for the CCECA electronics course at Chicago's Illinois Institute of Technology. Absorbed in a laboratory problem are (L to R) C. Peters, John Block, Lawrence Kaspari, and Frank Block.



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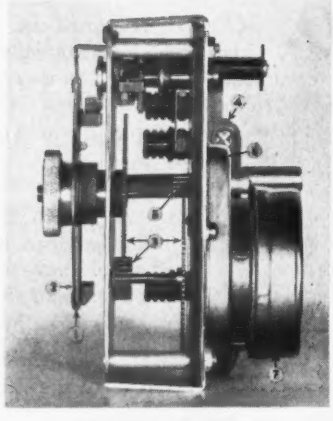
Has a fine record of success in wide variety of applications, e.g. for controlling motors, valves, pumps, blowers, oil burners, stokers, attic fans, commercial lights, signs, etc. Some outstanding features of the 300 series are: only 2 exposed gears, all others operate in a sealed oil-filled chamber; slow speed motor, sturdy clock train, snap-action switch; simple hand trip; attractive modern case; 2000% more dial power than required. Satisfactory service, workmanship and material guaranteed. Send for complete bulletin.



1 Simple, easy adjustment for times of operation.

2 42 lbs. operating pressure here. Only 2 lbs. required to trip switch. Thus operating safety factor—2000%.

3 Only two heavy wheels and one heavy pinion in entire open gear train. No other time switch can equal this simplicity.

4 30 Amperes heavy silver contacts. Heavy bronze switch blades.

5 1/32 R. P. M. here.

6 All motor reduction gears in sealed oil-filled gear box.

7 Heavy Duty Self-Starting Synchronous Motor—Slow initial rotor speed of 450 R. P. M.

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branch circuit over-current protection also, when used in cascade or as back up breakers?"—W.J.B.

A. The final sentence of paragraph "d" of section 2389 requires that a circuit breaker used for service equipment "shall be capable of interrupting the maximum short-circuit current to which it may be subjected."

This may be a rather severe requirement in places served from a network system which could deliver an immense amount of current into a short circuit. For instance, in New York City, the network could probably deliver 75,000 amperes under ordinary conditions.

While the Code gives only the general requirement quoted above, Underwriters' Laboratories require that circuit breakers be tested on a circuit connected to a supply capable of delivering not less than 5,000 amperes for a breaker rated at 100 amperes or less and not less than 10,000 amperes for breakers rated at more than 100 amperes.

CABLE IN CHICKEN COOP

Q. *"Is it within the Code, that is, is it permissible to wire chicken coops with non-metallic sheathed cable?"*—M.Z.

A. Reading the parts of Section 3362 pertinent to the above question we have:—"Non-Metallic sheathed cable shall not be installed in wet locations where subject to mildly corrosive fumes and vapors but not including chicken houses."

The effect of the double negative, which leaves a doubt in the minds of many readers as to intent, is to state that non-metallic sheathed cable may be installed in a chicken coop.

TWO CABLES THROUGH ONE HOLE

Q. *"In installing non-metallic sheathed cable, is it permissible to run more than one cable through the same hole if the hole is large enough for two or three cables?"*—E.A.

A. There is no prohibition against this in the Code. However many building inspectors will object to the weakening of floor beams or wall studs etc. if the holes are too big.

It has long been the practice in the installation of armored cable to have any holes through which the cable passes large enough to permit the cable to move away from or dodge a

nail. With non-metallic cable, this is even more important as a nail can very much more readily penetrate a non-metallic cable than it can a metal armored cable.

GROUNDING CONDUCTOR SIZE

Q. *"Does the grounding conductor for a non-metallic sheathed job have to be as large for a metal armored job, such as rigid conduit, armored cable or electric metallic tubing?"*—A.H.

A. The requirements for the size of grounding conductors are the same for all wiring systems.

For grounding the neutral conductor of the supply system, at the service equipment, the table in Section 2594 of the Code gives the size of the grounding conductor to be used in accordance to the size of the incoming service conductor.

For the size of a grounding conductor for grounding equipment (where such grounding might be required on a non-metallic sheathed cable job), the size of the conductor is given in the table in Section 2594. It will be noted here that such a grounding conductor might in some cases, be smaller than the circuit conductor. In practice, however, a cable with all assembled wires of the same size would probably be used.

A CONTRACTOR without instruments is like a doctor without a stethoscope, contends Wm. C. Schlosser, enterprising president of Capital Electric Co., Madison, Wis. Bill is doing a bang-up job on power factor surveys around the Madison area.

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Conditions of extreme heat, cold, moisture, vibration and corona are but some of the hazards to electrical insulation that are inherent in aircraft services. By carefully checking ignition harness, circuits and electrical equipment at frequent intervals with "Megger" Insulation Testers, aircraft maintenance men insure against electrical failures in flight.

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Likewise, industry is today guarding its electrical equipment more than ever before and "Megger" Insulation Testers provide the means for this protection. Write today for a copy of our *Pocket Manual of "Megger" Practice No. 1420-EC*—which presents the why and how of "Megger" testing.

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PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Circuits of Electronic Controls—II

Operation of all-tube time-delay relay, ignitron contactor and photoelectric relay is explained in this continuing article on circuit fundamentals.

By G. M. CHUTE

Application Engineer, General Electric Company, Detroit, Mich.

THE principle functions of electronic circuit operation *must* be understood before an attempt at maintenance is made. To provide this background, a series of three articles have been written as an introduction to a longer maintenance series to follow. This second article deals primarily with the circuits of:

4—*Time-Delay Circuit of a Spot-Welder Control*

To obtain a time-delay as short as one or two cycles, frequently needed for spot welding aluminum and other metals, an all-tube circuit is used as shown in Fig. 15. The purpose of the circuit is to permit thyratron tube 3 to pass current for just one-half cycle of the a.c. supply and then stop, even though the starting switch remains closed a longer time. (Later it will be seen that R9 may be adjusted to permit tube 3 to pass current for a greater number of half-cycles, if desired).

The a.c. supply forces current to flow only through tube 3; the timing circuit operates on d.c. Rather than use a battery or external d.c. source, this circuit provides its own d.c. supply by means of rectifier tube 1. This rectifier arrangement is frequently found in electronic controls. Briefly, the alternating voltage A, which appears at T1S (secondary of transformer T1), passes through tube 1; the positive half-cycle through the right-hand anode of tube 1, the negative half-cycle through the left-hand anode. The output from tube 1 cathode, shown as B, appears as a pulsating voltage, all the half-waves being of the same polarity. By means of reactor X and capacitor C1, this voltage is filtered or smoothed into a steady d.c. supply, which is positive at the top of the timing circuit, negative at the bottom, as C.

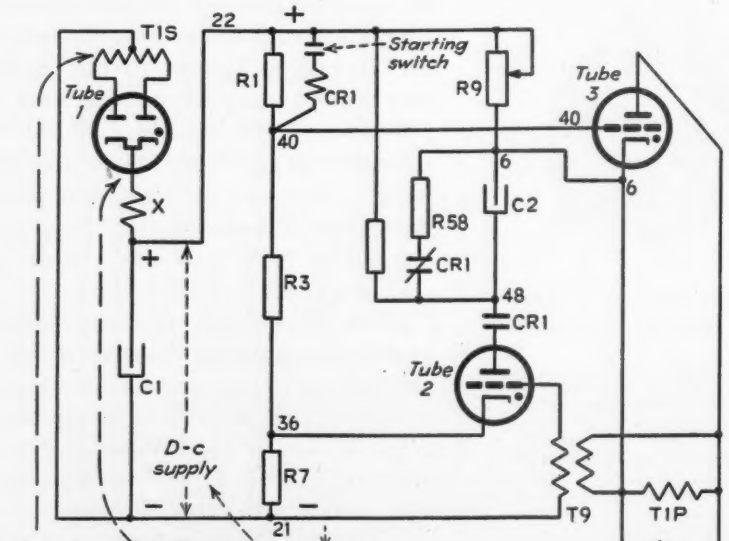
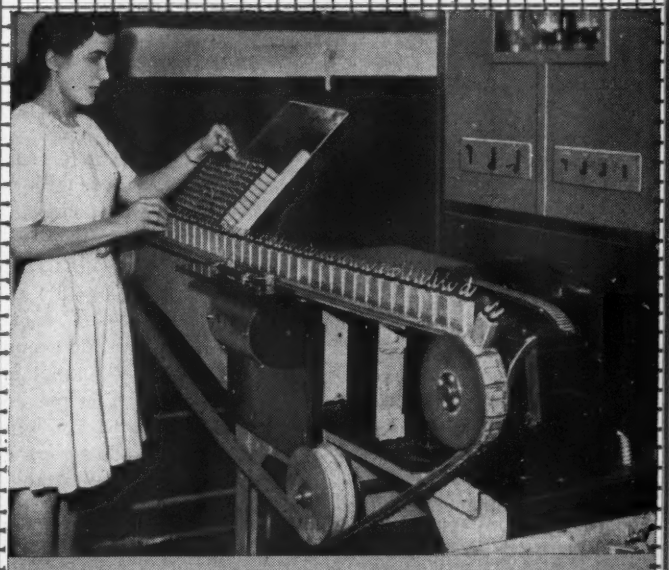


FIG. 15

Starting switch open—while the starting switch remains open in Fig. 15, let us examine the grid and cathode potentials of tube 3. The grid is connected to point 40, which is at some fixed potential more negative than point 22. (Resistors R1, R3, and R7 act together as a voltage divider, whose most positive potential is at the top. Point 40 is below 22 and therefore is more negative than 22; similarly point 21 is more negative than point 36). The cathode of tube 3 is connected to point 6 at the bottom of R9. However, since the starting switch has not picked up relay CR1, the CR1 contact above tube 2 is open, so there is no current flowing through tube 2 or R9; there is no voltage drop across R9 so point 6 (cathode of tube 3) is at the potential of point 22. Since the tube-3 grid (at point 40) is more negative than the cathode (which is at the potential of point 22), tube 3 cannot pass current. While relay CR1 is not yet energized, its normally-closed contact is connecting R58 across capacitor C2; there is no charge on C2, so points 6 and 48 are at the same potential.

Starting switch closed—when the starting switch closes, picking up relay CR1, then R58 is disconnected from

HOW AN RCA ELECTRON TUBE



This is the RCA electronic device that speeded up our radio condenser production by 2400%! It is powered with four RCA 833-A Power Triodes and six RCA 872-A Rectifier tubes.

DOES ONE SOLDERING JOB 25 TIMES FASTER

BUY MORE WAR BONDS

THINK what it would mean to be able to turn a production-line soldering job over to a tube...a tube that didn't tire, but did its work more quickly, more accurately, and with less solder waste than even the most expert solderer could possibly do manually.

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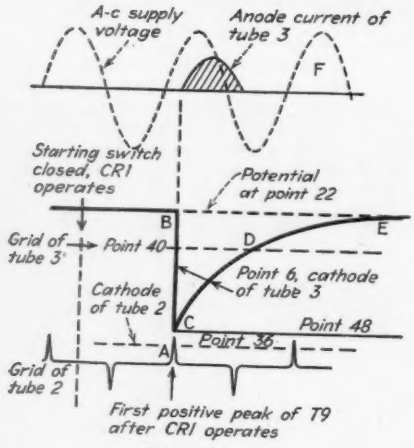

FIG. 16

C2, and C2 is now connected to the anode of tube 2. No current yet flows through thyratron tube 2, for its own grid is connected to point 21 which is more negative than point 36, the cathode. However, at one certain point in each cycle of the a.c. supply, transformer T9 produces a voltage peak (shown at A in Fig. 16) which fires tube 2. Therefore, no matter when CR1 picks up, tube 2 passes no current until the next positive peak of T9 occurs. When tube 2 fires, tube 3 instantly passes current also, as explained below.

It should be here mentioned that thyratron tube 2, although fired by such a brief voltage peak from transformer T9, continues to pass current as long as CR1 remains energized. Any vapor-filled tube acts in this way; its grid can prevent the tube from firing, but the grid has no further effect after the anode current once starts; only the removal of anode voltage can cause the current to stop.

When tube 2 passes current, this current flows from point 22 through R9 into capacitor C2, and through tube 2 to point 36 and through R7 to point 21. When a vapor-filled tube like tube 2 is passing current, the tube anode is about 15 volts more positive than its cathode (or we say that the tube voltage-drop is 15 volts). Therefore, the potential of point 48 is suddenly lowered (from its previous positive potential at 22, marked B in Fig. 16) to a value close to point 36, marked C. At the same instant, since C2 has no charge, and point 6 and point 48 are at the same potential, point 6 (cathode of tube 3) is also suddenly lowered close to point 36. Since 36 on the voltage divider has a potential considerably below point 40 (grid of tube 3), it is seen that the firing of tube 2 makes the cathode of tube 3 more negative than the tube-3 grid, so tube 3 fires.

Time-delay action—the time-delay action of Fig. 15 starts when tube 2 first passes current; this current flows into capacitor C2, at a rate which can be adjusted by resistor R9. As voltage now begins to appear across C2, the potential of point 48 (bottom of C2) remains fixed but the potential of point 6 (top of C2 and also the cathode of tube 3) rises as shown by line CDE in Fig. 16. When this cathode potential rises above the potential of the grid (at D), tube 3 cannot pass current during the following half-cycle marked F. In this way tube 3 is prevented from passing current during more than one half-cycle of the a.c. supply; moreover, thanks to the accurately-timed voltage peak of transformer T9, the current of tube 3 can start to flow only at one certain point in the cycle. These features are quite necessary in the accurate or synchronous control of a spot welder.*

In the complete welder-control circuit, of which Fig. 15 is only a part, thyratron tube 3 has a companion, tube 4; together these tubes act as an a.c. switch.

Electron tubes as an a.c. switch—Fig. 17 shows two thyratrons connected as an a.c. switch; they close

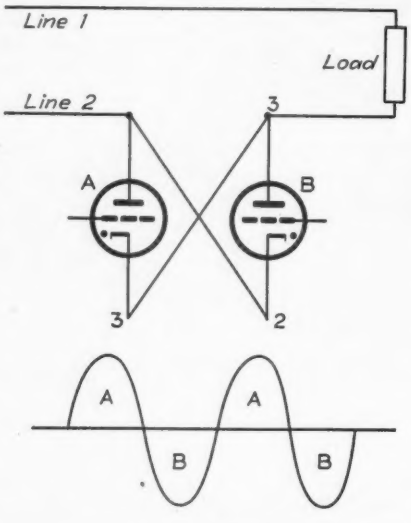

FIG. 17

or open the load circuit much like a single-pole contactor. Each tube by itself passes current in only one direction, but this connection of Fig. 17 permits a. c. to flow through the two tubes combined. This connection is called "inverse parallel", wherein the anode of each tube is connected to the cathode of its companion tube. To illustrate, when line 2 is positive (during half-cycle marked A), current passes down (anode-to-cathode) through tube A to point 3 and through the load to line 1. During the next half-cycle marked B, line 1 is positive, so current passes from line 1, through the load to point 3, down through tube B to line 2. When the grids of these tubes are kept quite negative (by circuits not shown), neither tube passes current, so the load circuit is open. Raising the grid potential, permits both tubes to pass current or "fire", and a.c. is applied to the load.

The resistance drop within these vapor-filled tubes cannot limit the amount of current flowing through them; when the grids permit anode current to start, the amount of that current depends on the load. A.c. loads as great as 25 amperes can be switched by the larger sizes of thyratrons.

5—*The Ignitron Contactor*

To switch a.c. loads greater than 40 amperes, another type of electron tube is used, called the ignitron. This tube is not heated; its cathode is a pool of liquid mercury, so the enclosure contains mercury vapor. Current flows through this vapor, from the anode to the mercury pool, but only after the flow is started or "ignited" by means of an ignitor, whose tip dips down into the mercury pool, as indicated by the tube symbol in Fig. 18. To fire an ignitron or make it pass anode current, the supply voltage must first force current (15 to 40 amperes) to flow from the ignitor into the mercury pool. This causes a tiny arc to appear at the ignitor tip, instantly ionizing all the mercury vapor, making it able to carry current from anode to cathode. This large anode current produces so much heat within the tube that most ignitrons are cooled by water flowing within a metal jacket surrounding the tube.

Fig. 18 shows two ignitrons connected as an a.c. switch or single-pole contactor, so as to close the circuit to a spot-welder transformer. Neither ignitron passes current while switches

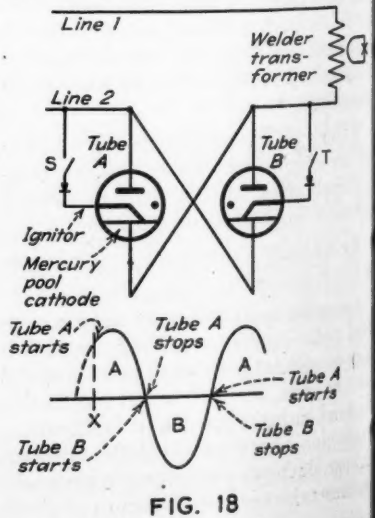

FIG. 18

* Such synchronous control is more completely described in "Electronic Control of Resistance Welding", McGraw-Hill Book Company, 1943.

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S and T are open. However, if you close both S and T at the point marked X (in half-cycle A, when line 2 is positive) ignitron A instantly passes current which flows during the rest of half-cycle A. However, ignitron B cannot pass current until half-cycle B (when line 1 is positive) and after the current of tube A stops.

Notice that the circuit through S and the ignitor is in parallel with the main anode-to-cathode circuit of tube A. When S closes, current first flows through S and the ignitor causing the arc which ionizes the mercury vapor in tube A. This instantly permits load current to flow directly from anode to cathode in tube A. The resistance of this main current path from anode to cathode is so much lower than that of the circuit through S and the ignitor, that the current flowing in the ignitor becomes negligible. As soon as the current stops flowing in tube A and the voltage at the anode of ignitron B has become more positive than its cathode, tube B is then "fired" in the same manner, by current flowing first through switch T and the ignitor, which instantly makes the mercury vapor in tube B able to carry the load current directly from anode to cathode. We see that, although the load current is carried mainly by the anode-cathode circuit, this flow must be started or "ignited" every half cycle separately.

Ignitor circuit—instead of two ignitor circuits controlled by separate switches, as in Fig. 18, the ignitors can be connected together through a single contact C, as shown in Fig. 19. With C closed and line 2 positive, current flows from 2, up through tube B from the mercury pool into the ignitor to 4, through C and into ignitor 5, to the mercury pool of tube A, to point 3, through the load to line 1. This "fires" tube A, which immediately passes current from anode 2 to cathode 3. Although this ignitor current fires tube A in normal fashion,

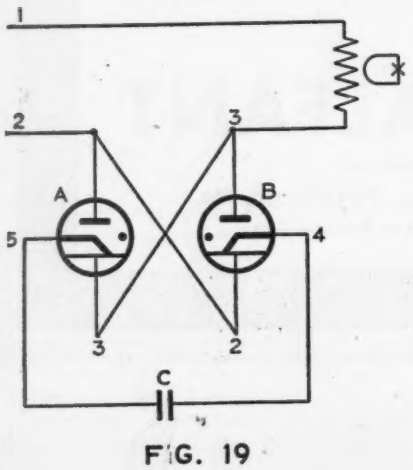

FIG. 19

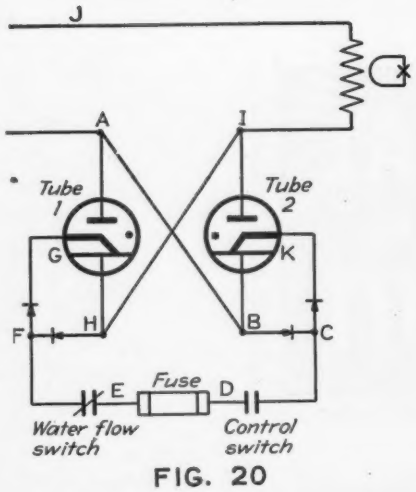

FIG. 20

this same current flows in reverse direction in tube B, or from pool to ignitor. Such reverse current definitely damages the ignitor and decreases tube life. To prevent this reverse current, copper oxide (metallic) rectifiers are added as shown in Fig. 20. Each rectifier is a stack of specially coated copper disks arranged so that they have low resistance to current flow in the direction indicated by the symbol arrow, but they have very high resistance to opposite current flow.

Figure 20 shows the circuit used in a commercial ignitron contactor. The ignitrons, connected inverse parallel, close or open only one side of the a.c. line. Both ignitrons pass current when the control switch is closed. To fire ignitron tube 1, the current first flows ABCDEFGHIJ. This current flowing into ignitor G causes tube 1 to pass current, which flows AHIJ. During the following half cycle, ignitor current flows first through path JIHFEDCKBA, which fires tube 2 so that load current then flows JIBA.

The control circuit CDEF carries each ignitor's current in turn. Although this current must reach 25 to 40 amperes momentarily to fire the ignitron, it flows such a small portion of each cycle that a 3- or 6-ampere fuse serves during normal operation. If an ignitron fails to fire or becomes "hard starting", the ignitor current flows a larger portion of each cycle, and blows the fuse. In the same circuit, the flow-switch contact opens when there is insufficient water flowing to cool the ignitrons.

In Fig. 20, the current flows steadily through the ignitron (each tube passing current during its own half-cycle) as long as the control switch remains closed. Later we will see how this control switch may be replaced by a pair of thyratrons, so as to fire the ignitrons with the greater accuracy needed in the synchronous control of welders.

6— *General-purpose Photo electric Relay*

Fig. 21 shows a light-sensitive relay which may be operated from either a.c. or d.c. power supply. As explained below, when sufficient light shines on phototube 3, this permits current to flow through tube 2 causing relay CR to "pick up" and operate its contacts to control external circuits.

If points 1 and 2 are connected to a 115-volt a.c. supply, the portion of Fig. 21 within the dotted line serves to convert this alternating current into a d.c. voltage which appears between points 8 and 1. That is, tube 1 acts as a half-wave rectifier which permits current to flow through it during only the half cycles when the tube 1 anode is positive. Since this tube-current flows only in one direction, it charges capacitors C1 and C2, which smooth this pulsating tube output into a usable steady d.c. voltage; in this way these capacitors and resistor R7 act as a filter. However, if points 1 and 2 are connected to a 115-volt d.c. supply (with the positive side at point 2), current flows steadily through tube 1 and R7, and a d.c. voltage again appears between points 8 and 1.

In circuits supplied only by a.c., the tube filaments often work at low voltage furnished by a small transformer. Since such a transformer cannot be used in Fig. 21 on d.c. supply, the tube filaments are designed to operate directly at supply voltage. Tubes 1 and 2 are built in one enclosure, using a single socket.

Between points 8 and 1 in Fig. 21, resistors R3, R4, R5, and R6 merely divide the d.c. voltage into usable parts. The current which picks up CR must pass from 8 through the CR coil, anode to cathode of tube 2 to point 10, and through R4 and R3. This tube current cannot flow when the control grid of tube 2 (at point 14) is considerably more negative than the cathode (point 10), as when the light beam at phototube 3 is interrupted. When phototube 3 is dark, it acts as a very high resistance, much greater than R1, so that the potential of point 14 is close to that of point 1, and therefore is more negative than point 10.

When the light beam reaches phototube 3, this phototube permits enough current to flow (from 8 through phototube and R1 to point 1) to cause a voltage drop across R1; this raises the potential of point 14 (grid of tube 2) so as to permit anode current to flow through tube 2 and pick up CR. If the R3 slider is turned clockwise, the amount of light required to operate the relay is increased. This increases the resistance and voltage

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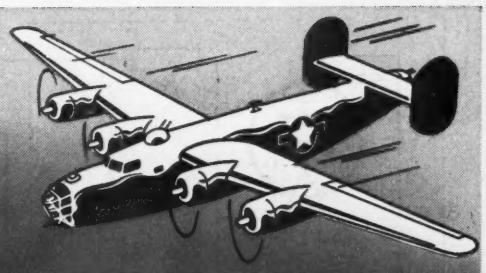

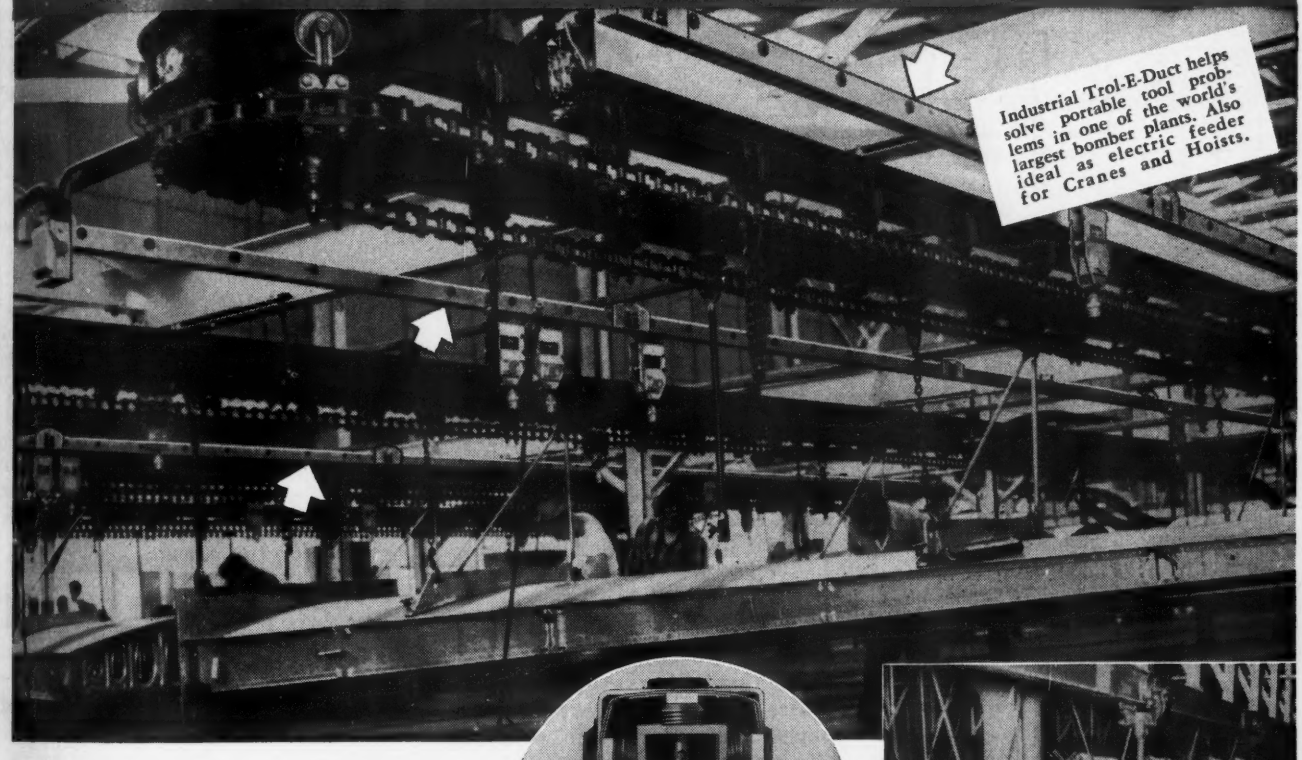

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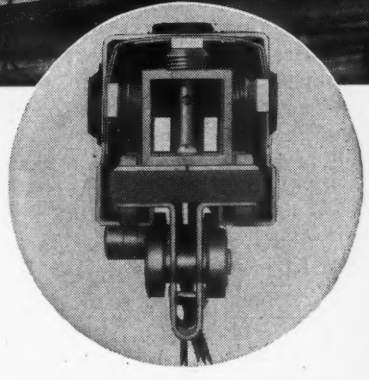

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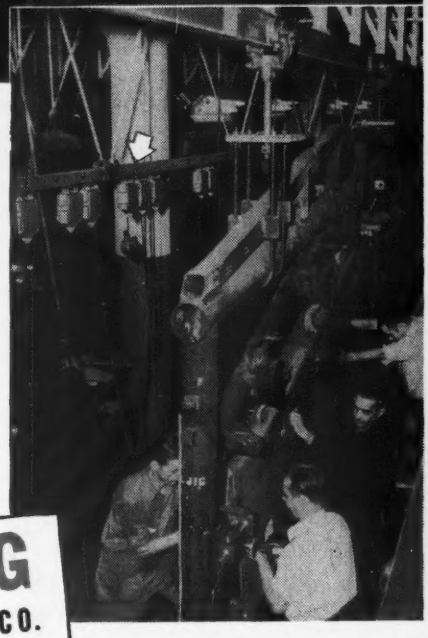

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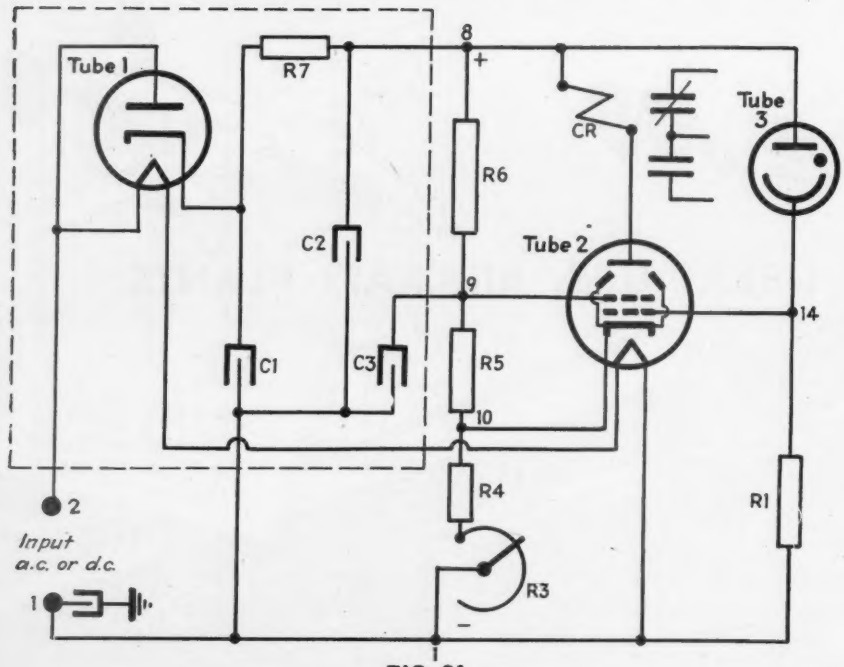


FIG. 21

drop between points 10 and 1, raising the cathode of tube 2 to a higher potential. To turn on tube 2 we must now raise its grid (14) to a higher potential also, and this requires more current flow through R1 and more light on phototube 3.

In describing the operation of tube 2, we have mentioned only one grid, as though tube 2 were a triode. In Fig. 21 the symbol of tube 2 shows that it is a beam power tube—a form of tetrode having deflecting plates connected to its cathode. This more complex tube gives superior performance but is controlled, in the same way as a triode, by means of the potential of one grid close to its cathode. The other grid is connected to point 9 whose potential is not affected by the phototube circuit.

Photoelectric Pyrometer

Very similar to Fig. 21 is the circuit of a photoelectric pyrometer shown in Fig. 22. Phototube 3 "looks at" a red-hot object, and causes tube 2 to permit just enough anode current to flow to make the instrument pointer indicate the temperature of the object.

This pyrometer circuit operates from an a.c. power supply; through transformer T1 and tube 1, this alternating current is rectified into pulsating d.c., then smoothed or filtered by capacitors C1 and C2 and reactor X. Since the resulting d.c. voltage (shown at A in Fig. 22) can change if the a.c. supply voltage fluctuates, a voltage-regulator tube (4) is added, so that a constant voltage is obtained at B, thereby causing more accurate performance of the pyrometer circuit.

Such a voltage-regulator tube contains a gas or vapor. Its cathode is not heated. It is the nature of such a tube to maintain a constant arc drop; whenever current flows through the tube, the voltage measured between its anode and its cathode remains at one steady value and does not change as the tube current changes with line voltage fluctuations.

The kind of gas used in tube 4 causes a constant 90 volts to be maintained at B; to give this result, tube 4 must operate in series with a resistor (R8) which absorbs any variation in voltage A. For example, if R8 is 5000 ohms and A is 140 volts, the voltage drop across R8 is 50 volts and the current flowing through R8 is 0.01 ampere or 10 ma. If voltage A rises to 160 volts, the voltage drop across R8 increases to 70 volts because tube 4 instantly increases its anode current by 4 ma, so that 14 ma flows through R8.

The 90 volts steadily maintained at B in Fig. 22 causes current to flow from 10 through the instrument to anode 11, through tube 2 to cathode 12, through R3 and R2 to 13. The amount of this tube (2) current is controlled by the potential at 15, which is the control grid of tube 2. Although tube 2 is a pentode (a five-element tube with three grids), notice that the upper grids are connected to constant-potential points 12 and 10. These extra grids give superior performance to this kind of tube, nevertheless they are disregarded in our study of circuit operation.

In Fig. 22, phototubes 3 and R1 perform the same as in Fig. 21. When receiving no radiant energy (such as light or heat radiated from a hot object), phototube 3 passes almost no current, so grid 15 is more negative than cathode 12; under this condition R3 is adjusted so that 0.5 ma flows through tube 2. However, as the object becomes red or white hot, much radiant energy reaches phototube 3, so that appreciable current flows from 10 through phototube 3 and R1, which raises the potential at 15 and causes tube 2 to permit more current to flow through the indicating instrument. The vacuum-type phototube and the pentode tube 2 assure more constant performance during months of continuous operation; each change of temperature observed by the phototube produces a definite change in current at the instrument, to give correct temperature readings at various parts of the scale.

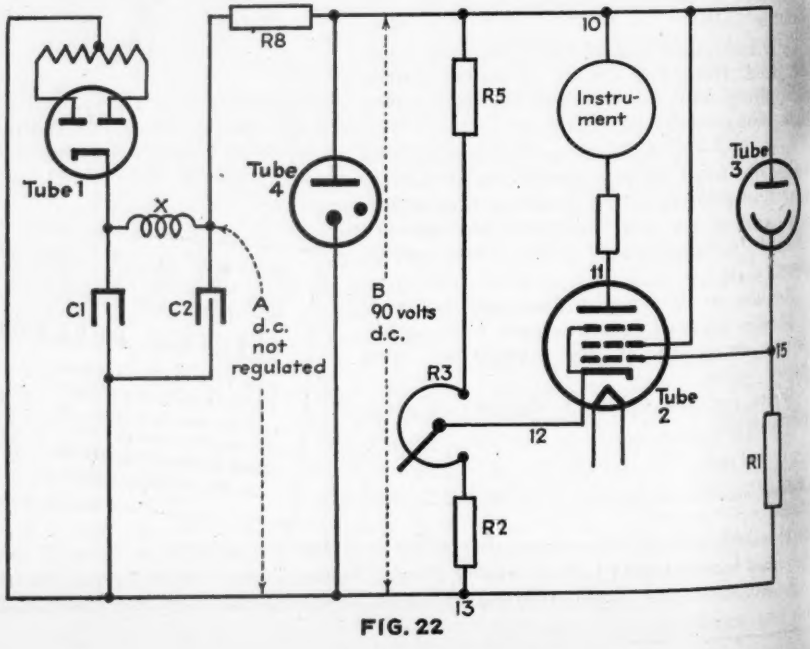
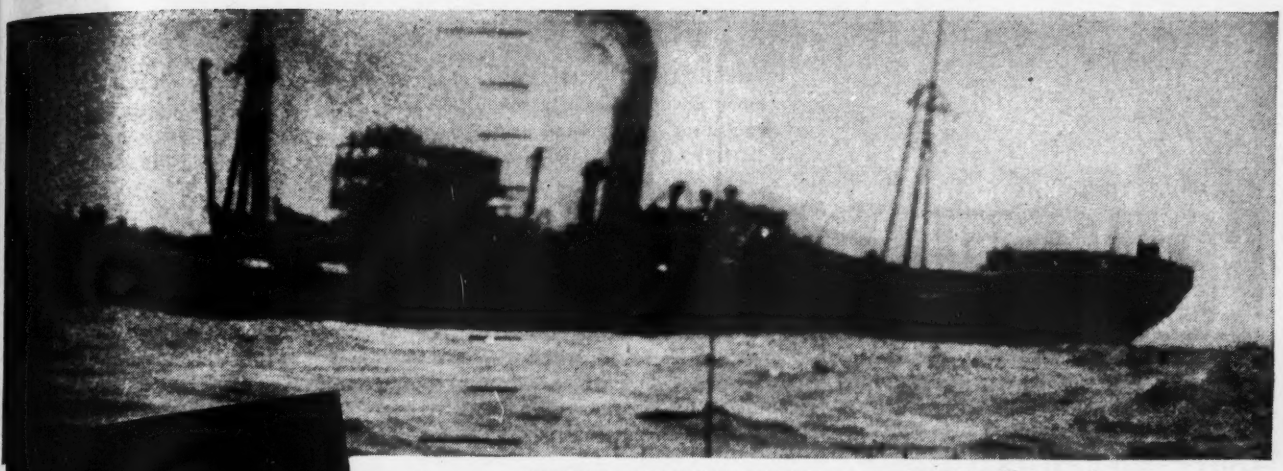


FIG. 22



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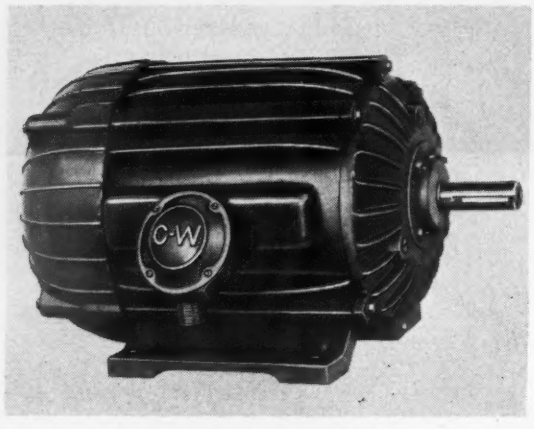

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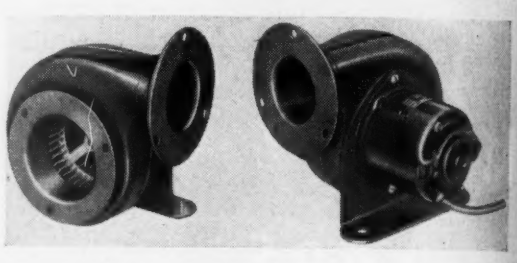

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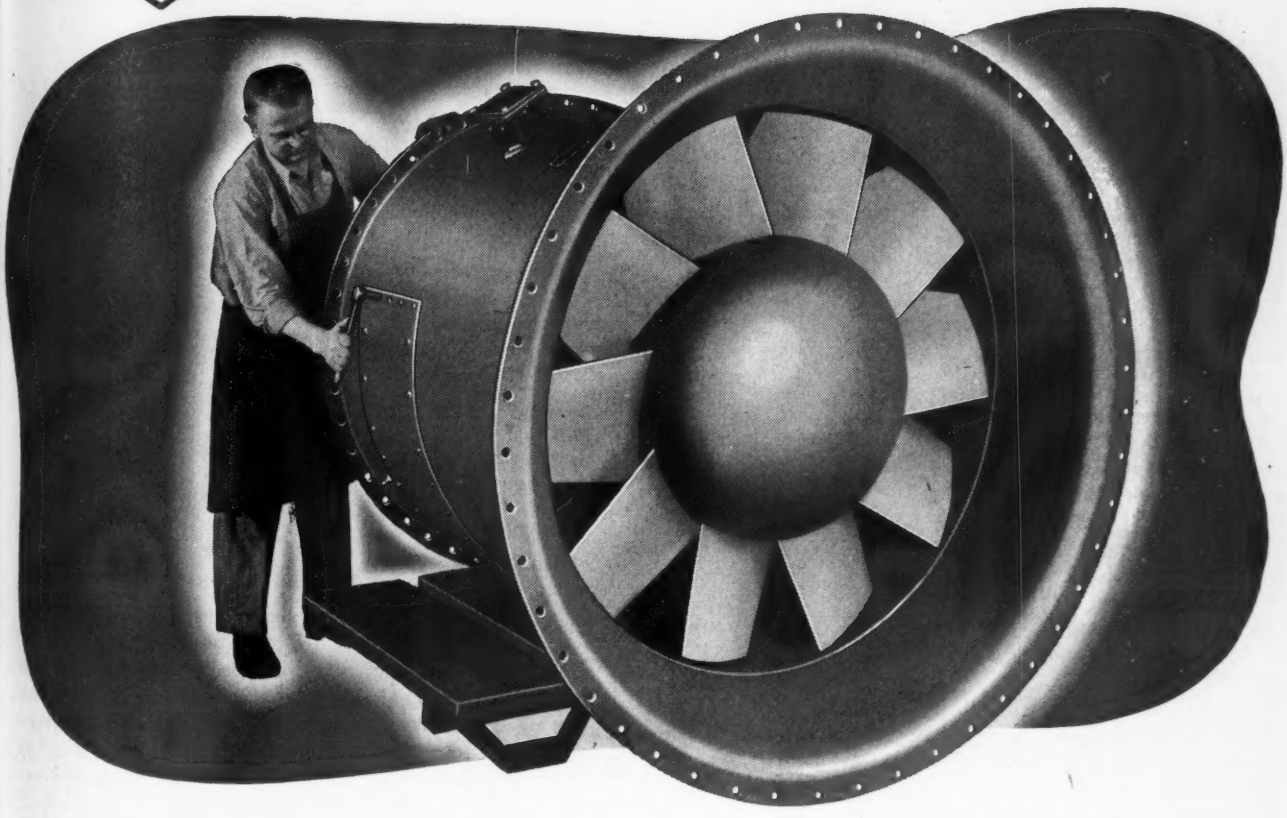

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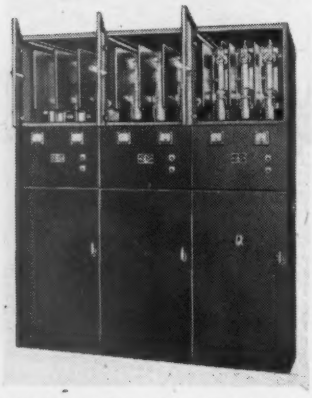
Control



ELECTRIC MACHINERY CONTROL

This new Hi-fuse control is designed for synchronous and induction motors. It combines dependable starting service with short-circuit protection through the use of split-cycle-operating, high-interrupting capacity power fuses. It gives complete protection for the motor against abnormal operating in starting or running. For synchronous motors it has the polarized field control. Hi-fuse controls can be furnished in live-front or dead-front, as well as the metal-enclosed type. Disconnect compartment doors are open to show fuses. Electric Machinery Mfg. Company, Minneapolis 13, Minn.

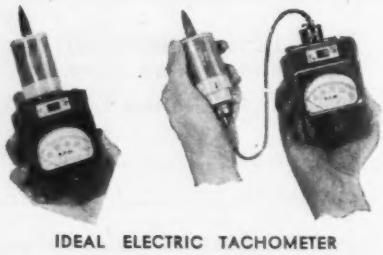
Air Blaster

This new air blaster delivers a large volume of air in a straight line to the spot where it is needed. It is recommended for use in steel mills, foundries, shipholds and forge rooms, meat packing and cold storage plants, freezers and dairies. Also for cooling condensers, ammonia compressors and transformers. The unit consists of a heavy guage steel housing, mounted on an adjustable pedestal which may be tilted 60 deg. up or down. It is driven by a direct connected, ball bearing motor. It is made in three sizes—18-in. ¾ hp., 6000 cfm motor; 24-in 1½ hp., 9000 cmf motor and 30-in. 1½ hp., 11,000 cfm motor. Chelsea Fan & Blower Co., Inc., 1206 Grove Street, Irvington, N. J.

CHELSEA AIR BLASTER

Tachometer

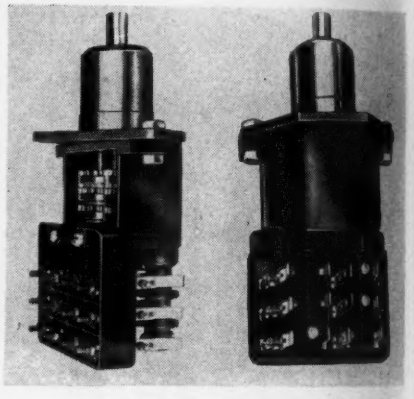
A self-energized tachometer that can be used either as a hand type or separable type. It is used in speed measurement for all testing, laboratory and production requirements. It consists of a small generator, coupled electrically to an electric meter. The meter or indicating instrument is a rectifier type, including a D'Arsonval movement. The generator and meter are made as separate elements and coupled together by a precision bayonet lock. The meter is provided with two scales. A small switch in the meter case provides for easy changing from the "Hi" to "Lo" range. A 5 ft. cord with coupling plug is provided but a cord up to several hundred feet long can be used. Size of generator only is 1⅝-in. dia. by 3¾-in. long. Size of meter is 3-in. by 4¼-in. by 2½ in. Size of complete unit is 3-in. by 7½-in. by 2½-in. Tachometer is available in two sizes for 0 to 2500 rpm. and 0 to 5,000 rpm. Ideal Commutator Dresser Company, 1041 Park Avenue, Sycamore, Ill.



IDEAL ELECTRIC TACHOMETER

Geared Limit Switch

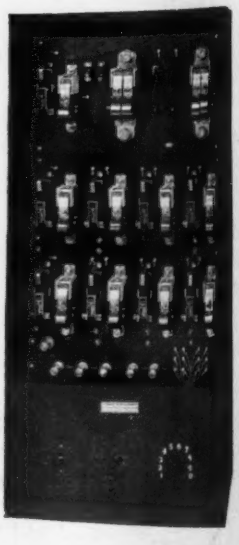
Two individually adjustable trains of intermittent gears are incorporated in this limit switch, with each train operating one contact drum having three double break contacts. Two of these contacts may be normally open and one normally closed or vice-versa. The switch can be adjusted for operation between 2 and 3333 turns of the driving shaft at speeds ranging from 10 to 500 rpm. Terminals are easily accessible. Contacts, which are of silver, are double break, and are self cleaning due to wiping action. The contacts are rated for voltage up to 550 volts a.c. or d.c. Mounting can be in any position and water-tight, weatherproof enclosures can be supplied. Philadelphia Gear Works, Inc., Erie Ave. & G Street, Philadelphia 34, Pa.



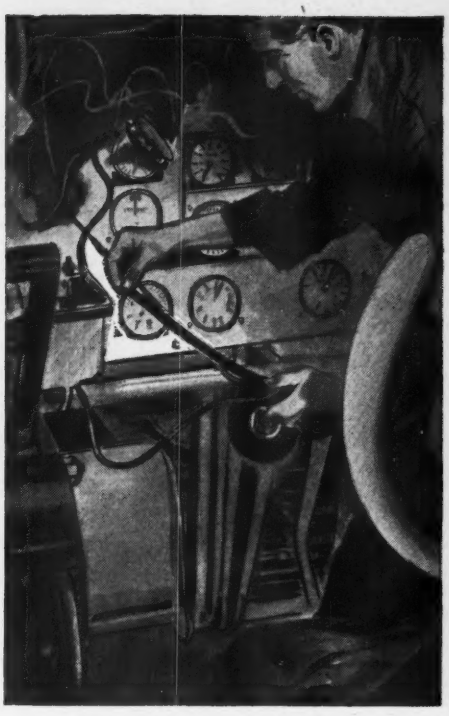
PHILADELPHIA LIMIT SWITCH

Magnetic Voltage Selector

This magnetic voltage selector was especially developed for a new electro-plating process, for anodizing aluminum on a.c., but it has many other uses where like applications of current are required. It is for transfering in steps from 2 to 40 volts. The arrangement is such that when transferring, the main contact opens before the secondary contact opens, and closes after the secondary contact is closed. Arcing is thus eliminated. The new unit embodies automatic main magnetic contacts and automatic main switch contacts for nine positions at 2½ volt intervals, from 2 to 40 volts. Zenith Electric Company, 152 West Walton St., Chicago 10, Ill.



ZENITH SELECTOR



HOW BIG IS TAPE? Just as big as the broken wire it restores to service—or the tank it helps to build. Big enough for it to be important that the Armed Forces and War Industries have first call on our production of U. S. friction and splicing tape.

FIRST AID FOR CANNIBALS

Down in the South Pacific, ground crews cheerfully turn cannibals... all for the sake of keeping planes in the air. A plane limps home after downing a Zero... scutters to a lameduck landing... and is immediately looked over by the "grease monkeys" and mechanics. Then... they turn cannibals. That's what they call the boys who snatch parts from planes to repair others. Other planes, too badly shot up to be flown again, are kept as a sort of salvage depot. Parts, from landing wheels to sparkplugs are used again in other planes... used again and again.

Right there is where tape comes in. Without it, many emergency repairs could not be made... wire could not be spliced... parts could not be fastened in place... planes could not again leave the ground.

A roll of tape in itself is a *mighty* little thing. But... in actual use by the Armed Forces, by war industries it gets as big as the job it is called upon to do.

Listen to the Philharmonic Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E. W. T. Carl Van Doren and a guest star present an interlude of historical significance.

SECURITY ON ALL FRONTS

UNITED STATES RUBBER COMPANY

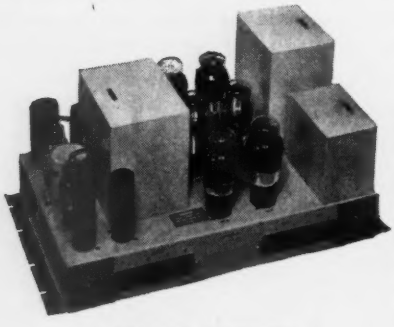
1230 SIXTH AVENUE · ROCKEFELLER CENTER · NEW YORK 20, N. Y.

Spotlight

G-E SPOTLIGHT

A new spotlight designed for an arc welding operator to see through the dark lens of a welding helmet prior to striking the arc. It is especially desirable for production-line welding. Mounted on an upright, telescoping metal standard, spotlight consists of three 300-watt reflector spot lamps surrounded by a circular shade. The light can be raised or lowered on its standard and held in place by a locking thumb screw, to any point from 45 to 76 inches above the base. Controlled by a foot-operated switch which is depressed by the operator while the arc is struck, the unit is equipped with a 10-foot, oilproof, heavily jacketed cable, with plug for connecting the light to the electric circuit. General Electric Co., Schenectady, N. Y.

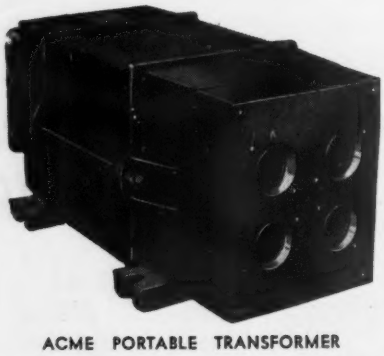
Amplifier



LANGEVIN AMPLIFIER

This new commercial amplifier is known as Type 101-A. It gives low-frequency wave form at high output levels. Inherent noise level is 68 db unweighted below full output of plus 47 VU at two percent RMS harmonic distortion. With the input impedance of 600 ohms, the gain is 60 db. Using bridging input, the gain is 46 db. Output impedance is adjustable 1 to 1000 ohms. The Langevin Company, Inc., 37 West 65th Street, New York 23, N. Y.

Transformer



ACME PORTABLE TRANSFORMER

A one kva. air cooled unit, supplied for either 440 or 220 volt primary and arranged with dual fused secondaries of 110 volt each, has been developed for use of small portable tools or inspection lights. This transformer may be carried and connected to the power line nearest the point where the 110 volt lines are temporarily needed. Fuse receptacles in the secondary are a protection that may be quickly and conveniently replaced on the spot, without inspecting the main switchboard. The Acme Electric & Mfg. Co., Cuba, New York.

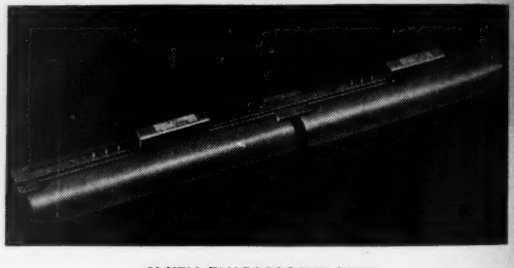
Splash Proof Motor

CENTURY MOTOR

Form J splash proof motors in sizes 1½ to 15 horsepower are now available with two-way ventilation. The cooling air is drawn in through baffled openings in the bottom of the end brackets by a fan on each end of the rotor, blown through and around into all parts of the motor; and out through louvred openings in the side of the frame below the center line and at the bottom. This construction protects the vital parts of the motor during plant wash down or for outdoor operation. Century Electric Company, St. Louis 3, Mo.

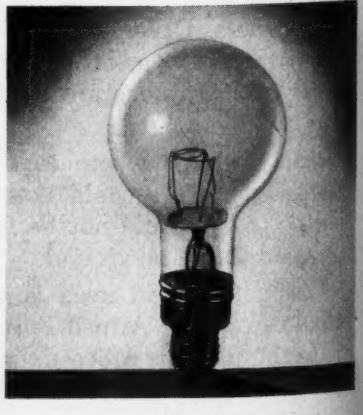
Fluorescent Units

This new fluorescent lighting unit provides basic 8-feet 6-inch sections for continuous row fluorescent lighting systems. Economies in installation are claimed because of the double length basic units. It is claimed that these units, together with 4-foot 3-inch fill-in sections, provide an efficient and economical method of installing continuous row systems to obtain illumination levels of 50 or more foot-candles. A. L. Smith Iron Company, Chelsea 50, Mass.



SMITH FLUORESCENT UNIT

Superlock for Infra-Red Lamps



BIRDSEYE SUPERLOCK

A new heat-proof superlock construction for infra-red lamps has been announced. It permanently locks base and bulb against the terrific temperatures of infra-red tunnel use. This new construction uses no cement or strap. It includes a base lining made with special protrusions fitting tightly into indentions in the neck of the bulb and locked in position by special crimping of the metal base. A ceramic heat reflector disc replaces the mica disc formerly used. Birdseye Division of Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y.

THIS LABEL HAS STOOD AS A SIGN OF QUALITY IN INDUSTRIAL LIGHTING FOR MORE THAN 21 YEARS

RLM STANDARDS INSTITUTE
INCORPORATED

BENJAMIN ELECTRIC MFG. COMPANY
Des Plaines, Illinois

BRIGHT LIGHT REFLECTOR CO. INC.
Brooklyn, New York

DAY BRITE LIGHTING, INC.
St. Louis, Missouri

GOODRICH ELECTRIC COMPANY
Chicago, Illinois

JONES METAL PRODUCTS COMPANY
West Lafayette, Ohio

THE MILLER COMPANY
Meriden, Connecticut

OVERBAGH & AYRES MFG. COMPANY
Chicago, Illinois

QUADRANGLE MANUFACTURING CO.
Chicago, Illinois

SMOOT-HOLMAN COMPANY
Inglewood, California

WESTINGHOUSE ELEC. & MFG. CO.
Cleveland, Ohio

WHEELER REFLECTOR COMPANY
Boston, Massachusetts

THE CERTIFICATE OF UNIFORM QUALITY

Yesterday—

To improve industrial lighting practice was the guiding motive behind the founding of the RLM Standards Institute.

It was founded as an organization not for profit, to encourage wider acceptance of *scientifically engineered* industrial fixtures, and to secure the widest possible acceptance of performance specifications for such fixtures. The aim was to make use of every available foot-candle of light, so that every fixture bearing RLM approval would be instantly recognized by the buyer as a guaranteed lighting product of high quality.

In this the RLM manufacturer members have succeeded . . . buyers of industrial lighting fixtures instinctively select those bearing the RLM label, knowing that they are getting for their plants the best in efficiency, economy, and long life.

Objectives of the Institute

To make, or cause to be made, and to supervise tests, investigations, experiments and inspections in connection with the manufacture and marketing of lighting equipment, lighting fixtures and pertinent accessories thereto.

- To formulate, administer and disseminate specifications of standards in design, construction, composition, finish, performance and service of lighting equipment, and to secure compliance with such specifications on the part of the members of the RLM Standards Institute, and others.

- To issue publications, bulletins, certificates, labels, and other printed matter in order to properly inform the public and all others using, specifying, installing or distributing lighting equipment about such tests, investigations, experiments and inspections.

- To promote, encourage in the public mind by publicity a keener interest in the advantages of the modern lighting equipment.

- To promote friendly and intelligent co-operation among its members and with other associations, organizations and institutions interested in the same or similar objectives.

In fulfilling these objectives, RLM Standards Institute has simplified the selection of fixtures properly designed and built for providing efficient and effective industrial lighting . . . as buyers have come to recognize that fixtures bearing the RLM LABEL comply in every respect with sound standards in design, construction and performance.

TH YMBOL OF COLLABORATION FO *Quality* AND *Progress*

Pioneers in industrial lighting r 21 years, members of RLM Standards stitute have worked together to give eep significance to the RLM label. It has ome to symbolize certain carefully engi- eered industrial fixtures that give

★ Engineered Lighting

★ Economy through More Light at No Extra Cost

★ Low Maintenance Costs and Long Life

★ Instant recognition by buyers of these guaranteed qualities, in industrial fixtures bearing the RLM label.

Thus RLM fixtures are more readily bought, more easily sold.

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There is a universally recognized forward trend in modern lighting, fostered by the Institute and individually by its members. Continued progress will be made in providing better lighting for better *seeing*—made possible by an unusual type of engineering co-operation under the guidance of strong and enlightened leadership.

50 Foot-candles in 1950

While 50 foot-candles has become standard lighting practice in some of the more progressive war plants, there are still innumerable plants, offices, schools and other establishments where the average lighting ranges from 10 to 18 foot-candles.

This, then, is a tremendous field which RLM Standards Institute will continue to cultivate . . . so that by 1950 the minimum accepted standard for general lighting, and for every seeing task will be 50 foot-candles.

To Sell More Than Fixtures—Sell Illumination

The lighting fixture is primarily a means to *illumination*. The illumination problem must be clearly understood, if the *right* fixtures to solve it are to be purchased. RLM Standards Institute has long recognized this fact and new specifications to meet the great changes of tomorrow's world will follow this pattern.

RLM Standards Institute and its members, in the future, will continue to educate the architect, engineer, contractor, property owner and manager, etc. to recognize this fact: *that the point of attack on any illumination problem* is to avail themselves of the lighting experience and lighting data of the RLM Institute, its members and their distributors.

New Testing and Inspection Specifications

In co-operation with Electrical Testing Laboratories, a Committee of the Institute is developing a set of testing and inspection specifications to be used in connection with the various lighting specifications which will not only form the basis of the inspection and testing methods used by Electrical Testing Laboratories but may also be used by any governmental or other testing agency to check results whenever desired.

Other research and educational work is in progress now, by the Institute and by its members, looking toward the post-war world when the many technological advancements of war will be utilized to make man healthier and happier in his home and at his work. And foremost among the factors contributing to increased health and happiness is—"Better Light for Better Sight."

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

RLM STANDARDS INSTITUTE
INCORPORATED

7 NORTH MICHIGAN AVENUE • SUITE 1600 • CHICAGO 1, ILLINOIS

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THE CERTIFICATE OF RLM UNIFORM QUALITY

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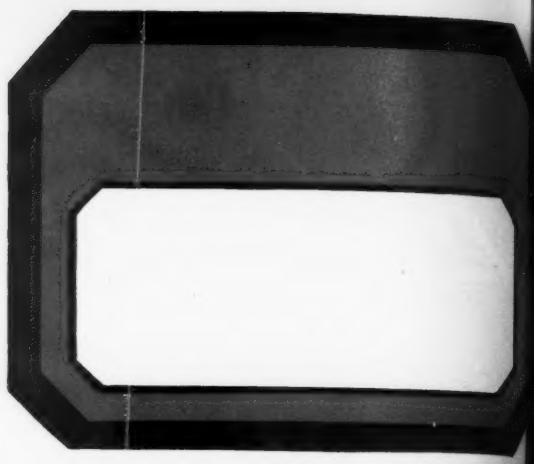
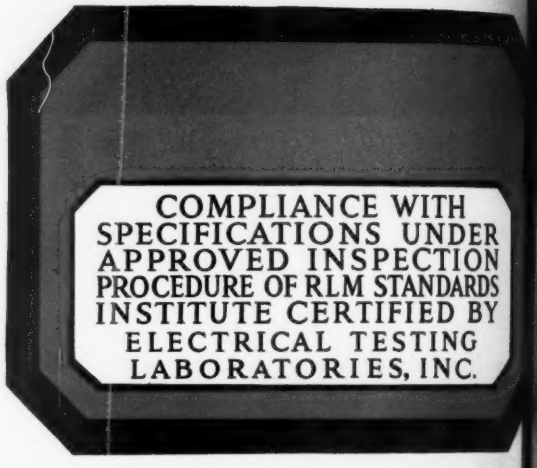
On each **RLM** *fixture*_____



*Statement of conformity*_____



For 24 years, continuous inspection and certification by

Electrical Testing Laboratories, Inc.

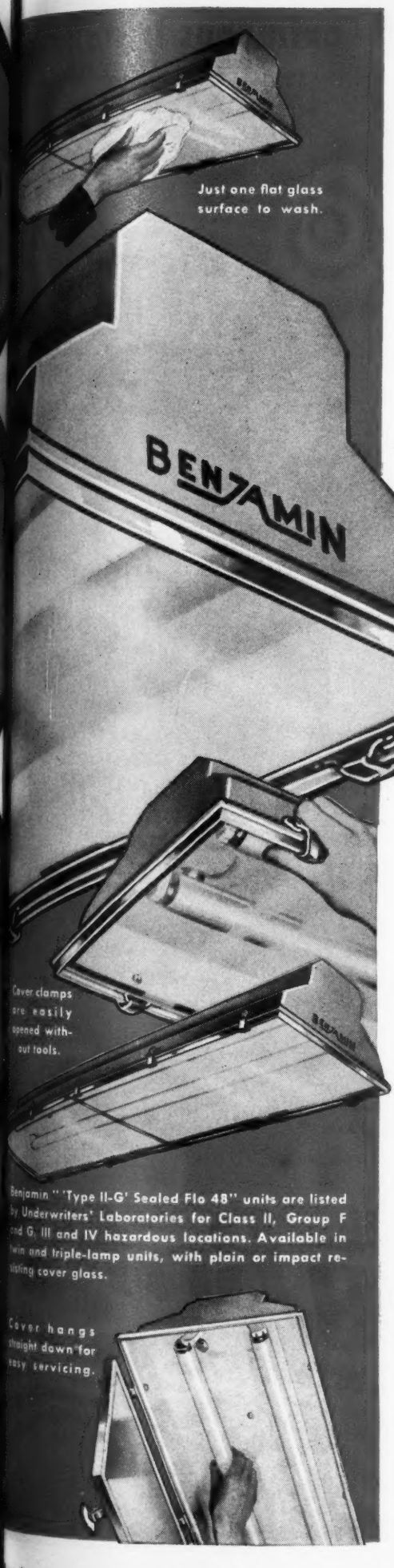
2 East End Ave. at 79th St., New York 21, N. Y.

These manufacturers are at present entitled to this identification:

CERTIFIED TYPES

Manufacturer	*Fluorescent Luminaires*			*Incandescent Lamp Reflectors*		
	2-40	*3-40*	*2-100*	*Dome*	*Bowl*	*Angle*
ABOLITE				X		
BENJAMIN	X	X	X	X	X	X
BRIGHT LIGHT	X	X	X	X		
DAYBRITE	X	X	X			
GOODRICH				X	X	X
MILLER	X	X	X	X		
QUADRANGLE				X	X	
OVERBAGH & AYRES	X		X	X	X	X
SMOOT-HOLMAN	X	X	X	X	X	X
WESTINGHOUSE	X	X	X	X	X	X
WHEELER	X	X	X	X	X	X

Specify Benjamin SEALED-FLO *Fluorescent* LIGHTING UNITS


Just one flat glass surface to wash.
BENJAMIN
Cover clamps are easily opened without tools.
Benjamin "Type II-G' Sealed Flo 48" units are listed by Underwriters' Laboratories for Class II, Group F and G, III and IV hazardous locations. Available in twin and triple-lamp units, with plain or impact resisting cover glass.
Cover hangs straight down for easy servicing.

✓ ***For More Light*** *in departments with adverse atmospheric conditions*

✓ ***For More Easily Sustained High Lighting Levels***

✓ ***For Simplified Maintenance***

To secure the advantages of fluorescent lighting where combustible dusts in the atmosphere may create fire and explosion hazards and where maintenance due to dirt and vapor is a problem, specify Benjamin Type II-G "Sealed-Flo 48" units.

Dust-Tight and Vapor-Tight

These extremely durable, porcelain enamel fixtures, with their one-piece steel reflector and special type glass cover seal the interior against dust and dampness. All that is required to maintain the rated output of these units is cleaning the cover glass and re-lamping when needed. Exclusive Benjamin constructions embodied in these units reduce maintenance time to a minimum. Cover clamps are easily opened by hand; hinged cover facilitates re-lamping.

High Lighting Efficiency

In general lighting installations, Twin-Lamp Sealed-Flo units provide lighting levels ranging from 20 to 48 footcandles at normal mounting and spacing. Triple-lamp units provide approximately 28 to 65 footcandles. These units are also widely employed for local lighting of inspection tables, production lines and machines. Twin-Lamp units provide up to 100 footcandles and Triple-Lamp units up to 135 footcandles for such applications.

Listed by Underwriters' Laboratories for Certain Locations Requiring Dust-Tight or Vapor-Tight Lighting Units

These units satisfy all Underwriters' requirements for Class II, Group F and G hazardous locations, Class III and IV locations. They are available on the same priorities as other industrial fluorescent and incandescent equipment. For further details and complete data on these units

Write for free Data Bulletin today

Benjamin Electric Mfg. Co.

Product Information Department H, Des Plaines, Illinois

BENJAMIN TRADE MARK

Lighting Equipment

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

THE CERTIFICATE OF REA UNIFORM QUALITY

THE CERTIFICATE OF UNIFORM QUALITY

The DAY-LINE... For Single Unit or Continuous Installatio

13 POINTS Tell Why You Save

INSTALLATION and MAINTENANCE DOLLAR

1. 5-second on-and-off spring tension clips permit instant release and replacement of entire reflector.
2. ½" K. O. for cable clamp installation direct to fixture.
3. Slide channel clamps for rod or pipe hangers can be located at any point on channel.
4. Swivel type hanger strap is adjustable for pipe or rod alignment.
5. K. O.'s for pipe and cord.
6. Rigid one-piece coupling converts, single units to continuous fixtures.
7. Chain hanger slots in top of channel and in center of coupling.
8. Complete pipe hangers with ceiling canopy and all fittings.
9. Large tear-out in end for through feed.
10. Rigid, one-piece, die-formed end boxes welded to channel assure rigidity and proper alignment of all parts.
11. Non-metallic reflectors (RLM and U. S. Bureau of Standards approved). Reflection factor, 85% or more. Angle of cutoff, 14°.
12. K. O. for switch.
13. Screw holes for direct surface mounting. No couplings needed.

Latest of the many exclusive design features that make Day-Brite the low-maintenance fluorescent fixture is the 5-second *on-and-off reflector.* Slight finger pressure on 2 spring-tension clips at each end of the fixture releases the entire reflector. To replace, merely snap back into rigidly held position. Works fast—permits instant accessibility to the fixture body . . . Long life, continuously high illumination effectiveness is assured by Day-Brite's exclusive "Super-White" baked enamel finish—standard on all non-metallic reflectors. Another low-maintenance feature!

The Day-Line is supplied for single unit mounting or continuous runs—for 2-40 watt, 3-40 watt and 2-100 watt lamps . . . Consult your Day-Brite engineering representative—send for Bulletin F-69.

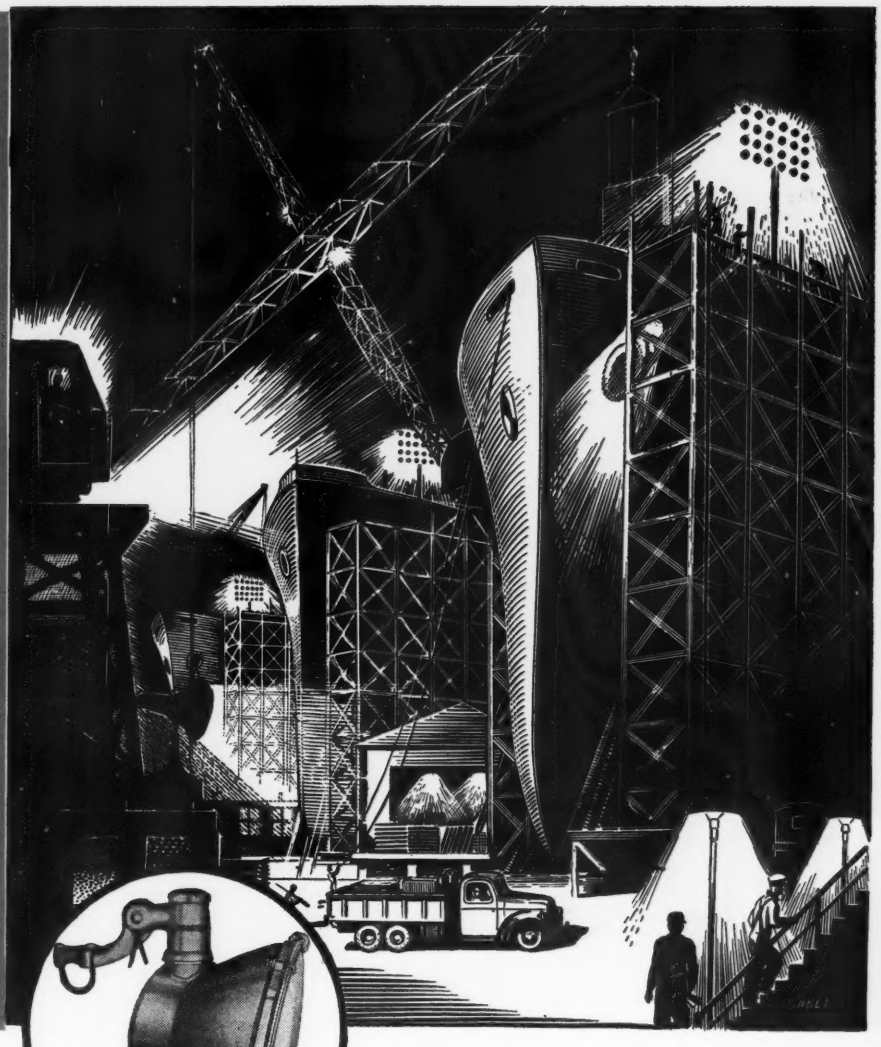
DAY-BRITE LIGHTING, INCORPORATED
5431 Bulwer Ave. — St. Louis 7, Missouri

DAY BRITE
The Sign of Quality
Look for this Label

Day Brite
LIGHTING FIXTURES

COMMERCIAL · INDUSTRIAL and SPECIAL DESIGNS

SEE-Power
that builds
SEA Power



THE CERTIFICATE OF RLM UNIFORM QUALITY

CONSIDER the part of lighting in our gigantic ship building program! It enables shipyards to carry on night-time operations with daytime efficiency and safety standards—and multiplies normal working hours by three. Fighting and cargo ships of all kinds are sliding down the ways ahead of schedule! *See*-power has become another American reality for the Axis to reckon with.

Here, again, Goodrich lighting equipment is providing *see*-power to bring Victory sooner. It is but one more example of the way Goodrich lighting specialists and Goodrich lighting are serving American industry. There's a Goodrich fixture to answer every industrial lighting need.

Sold Through Electrical Wholesalers

HIGHLITE

STOCKLITE

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RLM DOME

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

Protecting vital plants with floodlighting . . . saving man-hours in production . . . Goodrich lighting serves the war effort everywhere.

THE CERTIFICATE OF UNIFORM QUALITY

LIGHT

RIGHT with ABOLITE

One of the Oldest Names in Incandescent Lighting History

gaining New Friends Today faster than ever before among

ELECTRICAL CONTRACTORS

and the Essential Industries which they serve by providing

Good Lighting

so necessary for Increased Production

TO SPEED UP VICTORY

THESE LABELS ON

ABolite Incandescent Lighting Reflectors

are your assurance of high standard

Quality, Performance, Efficiency

Abolite Reflectors are now available in the three general types authorized by the War Production Board—
FORMED NECK—one piece—Socket type • HEEL NECK—one piece—Shade Holder type • THREADED NECK—Heavy Duty type.

RLM Standard Dome, Shallow Dome, Deep Bowl, Glass Steel Diffusers, High-Bay Lighting Units for Incandescent and Mercury Vapor Lamps, Open Type Floodlights.

Jones Incandescent Lighting Reflectors

provide proper and efficient lighting at economical cost

See our representative or write for copies of the

New Victory Line ABolite and Jones Reflector Catalogs

Field Representatives at your Service:—

New England Territory—
H. W. MacLEOD Co.,
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New York State Territory—
D. K. POST & CO.,
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Philadelphia Territory—
H. G. ANSCHUETZ,
117 N. 5th St., Philadelphia.

Baltimore Territory—
LEO T. McCOURT CO.,
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Southeastern Territory—
R. H. WITHERSPOON,
376 Nelson St., S.W., Atlanta.

Pittsburgh Territory—
Wm. E. HAWLEY,
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Michigan Territory—
K. T. BECK,
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Cleveland Territory—
L. P. COLEBROOK,
815 Hanna Bldg., Cleveland.

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ARTHUR L. EHLERS,
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Indiana Territory—
EMMETT E. VINCENT,
Box 555, R.R. 5, Indianapolis.

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McKINLEY-MOCKENHAUPT CO.,
626 W. Jackson Blvd., Chicago.

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C. H. JERDEE SALES CO.,
4336 Coolidge Ave., Minneapolis.

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HAWKINS ELECTRIC SALES CO.,
1706 Olive St., St. Louis.

Kansas City Territory—
HAWKINS ELECTRIC SALES CO.,
5518 Michigan Ave., Kansas City.

Southwestern Territory—
FRED H. SIMMER CO.,
103 Thomas Bldg., Dallas.

Pacific Coast Territory—
O. W. COOMBS,
1026 S. Olive St., Los Angeles.
21-25 S. Park St., San Francisco.

ABolite and Jones Reflectors are distributed exclusively through Electrical Wholesalers

RELIABILITY

THE JONES METAL PRODUCTS COMPANY

West Lafayette, Ohio

QUAD

★ Lighting will always be of utmost importance to industry whether engaged in regular or specialized work. Therefore, only those units which have proved themselves in actual, long-time service are deserving of recommendation by Contractors. QUAD Lighting Units have earned this recommendation—Contractors are almost unanimous in endorsing them. QUAD Units are modern . . . easily wired and installed . . . quickly detachable for cleaning . . . highly flexible in design. Construction is strong, porcelain finish is permanent, and units are weatherproof. Sell QUAD Units for industrial and commercial regular or unusual installations—indoor or outdoor. Possibilities are unlimited for present and future business.

QUAD . . . for today and for tomorrow . . .

Lighting UNITS

QUADRANGLE MFG. CO. CHICAGO COMPLIANCE WITH RLM STANDARDS

RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods

RLM Threaded Dome Reflector

QUADRANGLE MFG. COMPANY

Mfgrs. of Incandescent and Fluorescent Lighting Equipment

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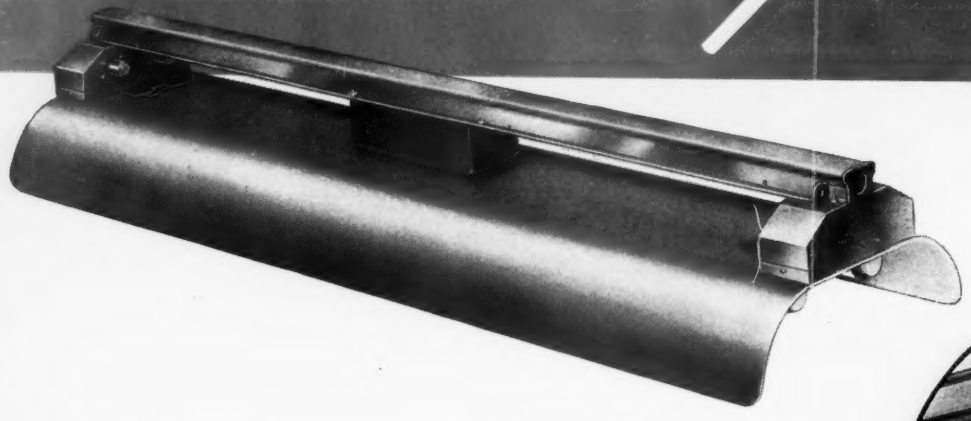
THE CERTIFICATE OF RLM UNIFORM QUALITY

THE CERTIFICATE OF UNIFORM QUALITY

Outside, Inside . . . it's *Skilled Lighting!*

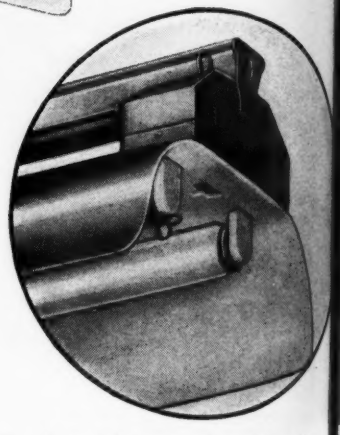


Compare a Wheeler **1944** RLM Fluorescent Fixture with any other fixture made in accordance with latest WPB requirements. Its trim, compact appearance truly indicates its simple, sound engineering, *outside and in!*

Wiring channels, for example, are hollow steel I-beams combining light weight and extreme rigidity. Provide durable support, easy adjustable suspension, instant access to starter switches.

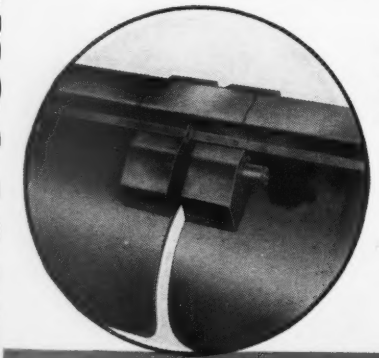
The reflectors, too, are typical Wheeler "Skilled Lighting" . . . designed with the "know how" of 62 years' experience. Made from tough, non-flammable, moisture-resistant material . . . chip-proof, washable enamel, inside and out. Rugged, light-weight, durable. And higher in lighting efficiency than many porcelain-enameled metal reflectors!

Write for detailed Bulletin 72. **Wheeler Reflector Co., 275 Congress St., Boston 10, Mass., . . .** New York City. Representatives in principal cities.

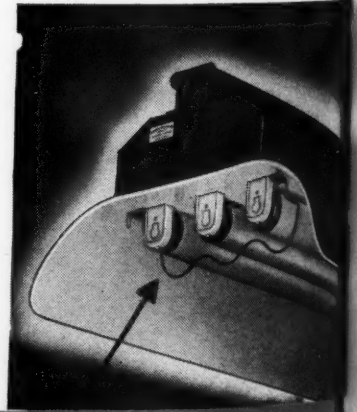


Rigid, weight-conserving wiring chann Easily accessible operating parts. Ref tion factor not less than 85% gives bet than 80% overall efficiency in 48" two-la units, 76% in three-lamp units. 74% in two-lamp units.

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS



Continuous Installations easily made by simple connection of adjacent ends with speedily-applied couplings. Note accessibility of starter switches.

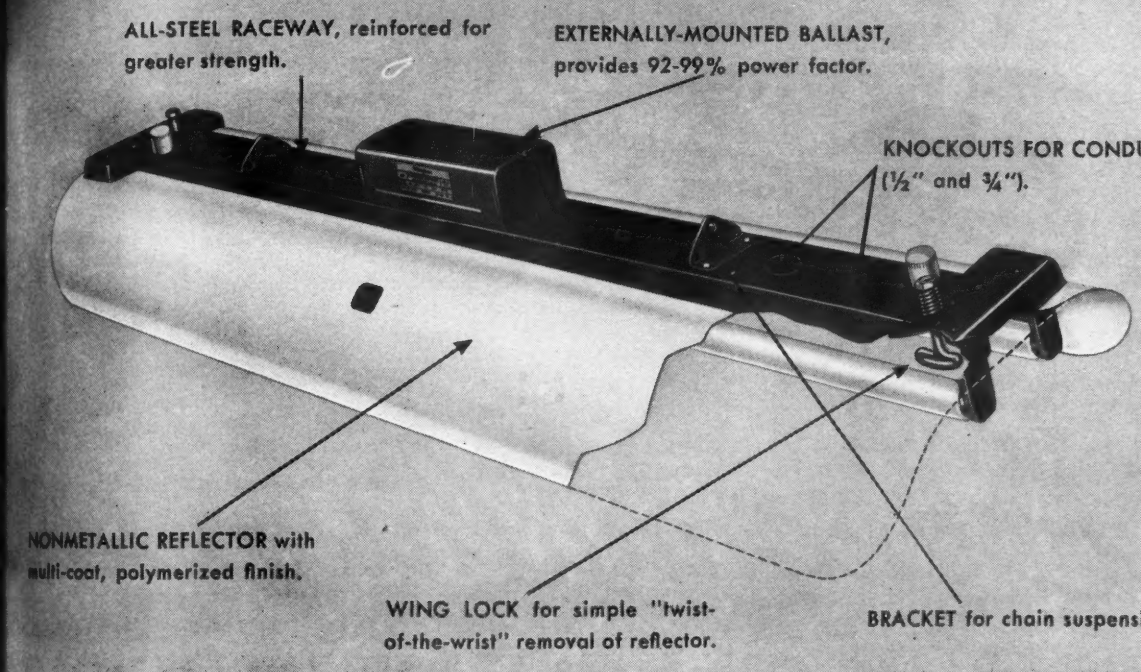


Another Wheeler improvement! New Lamp Retaining Guard for modern fluorescent fixtures. Provides new safety . . . positively prevents falling lamps. Easily attached . . . 2 per fixture. Available for two and three lamp 40-watt units and two-lamp 100-watt units.

Wheeler REFLECTOR COMPANY

LIGHTING EQUIPMENT SPECIALISTS SINCE 1881

DESIGN FOR BETTER LIGHTING


ALL-STEEL RACEWAY, reinforced for greater strength.
EXTERNALLY-MOUNTED BALLAST, provides 92-99% power factor.
KNOCKOUTS FOR CONDUITS (½" and ¾").
NONMETALLIC REFLECTOR with multi-coat, polymerized finish.
WING LOCK for simple "twist-of-the-wrist" removal of reflector.
BRACKET for chain suspension.

Westinghouse Industrial Luminaires . . . Easy to Install . . . Easy to Maintain

Westinghouse Industrial Luminaires, now in use in thousands of vital war plants, have won unanimous approval from both industry and electrical contractors. Industry needs and demands these luminaires because they provide highly efficient, glareless illumination . . . with little maintenance and replacement. Electrical contractors, busy with war work, find these attractive luminaires ideal for quick, easy, time-saving installation.

For example, the hood may be suspended any one of four ways. Reflectors are held in position and fastened to the channel by simple twist-turn latches. Line connections may be quickly spliced to fixture leads.

Design and construction of these Westinghouse Industrial Luminaires follow rigid RLM Standards Institute specifications, and are approved by Underwriters' Laboratories.

This industrial Luminaire is available for use with two or three 40-watt and two 100-watt Mazda F Lamps, in individual units or continuous strip installations. Any one of 117 Westinghouse Electric Supply Company Offices and Independent Lighting Distributors will give you full details regarding these efficient luminaires and their installation. Or write Westinghouse Electric & Manufacturing Co., Edgewater Park, Cleveland, Ohio, for Booklet B-3265.

Westinghouse *Lighting Equipment*

Plants in 25 cities . . . Offices everywhere

THE CERTIFICATE OF RLM UNIFORM QUALITY

Congratulations

ON A FINE JOB, WELL DONE!

THE Treasury "Star" Flag—the bond-buying counterpart of the Army-Navy "E"—marks plants with at least 90% of personnel participating in the Payroll Savings Plan to at least 10% of gross payroll, *and also having reached, or topped, a War Loan Drive quota!*

The successful close of the 4th War Loan Drive finds many more "Star" Flags than ever before flying over the industrial plants of America. To all these, go the heartiest thanks of the nation, and the deep appreciation of the Treasury Department for a great job! And to those who may not quite have qualified for the "Star," go equally sincere thanks—and the confidence that soon they, too, will join the ranks of the "Star" fliers.

One thought that many concerns have found helpful in stepping up the intake from their Payroll Savings Plans is this. In many cases the Treasury Representative in a plant has been able to point out the fact that during *Loan Drive periods* the employees have found it possible to spare much more than they had counted on when setting up their original subscription, and that—*when properly approached*—a very substantial fraction of such employees will decide they can well afford a distinct increase in their current Payroll Savings Plan.

Talk this over with your Treasury Representative—it offers important possibilities when correctly handled. And again accept the Treasury Department's congratulations for your fine work in helping to put over the 4th War Loan.

LET'S **ALL** *KEEP BACKING THE ATTACK WITH* **WAR BONDS**

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL CONTRACTING

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council.

Your Tax Record

[FROM PAGE 47]

form. Each sheet, two sides, should take care of 100 entries. If not enough for one year, use additional sheets, but at the end of the year, rule off, total and start another sheet. Clip quarterly returns (W-1), withholding reports given employees (W-2), reconcilement return (W-3) and canceled checks for tax payments to the yearly payroll record and file in your "Tax File" for ready reference. The foregoing forms are exact duplicates of those sent Collector. Always keep duplicate copies of tax returns.

Adjust this specimen form to suit requirements. Total deductions according to depository payments and payments to Collector. For example, if you make payment to a depository bank monthly, total deduction monthly and write in on the "Total" line, "Paid $..... to depository on ..... 1944". After each quarter, rule off and total, writing in "Paid $..... to Collector. Form W-1", and similar information if making payments on other type taxes withheld on wages.

The law permits you to retain the deductions for the final month in each quarter, mailing this money with two depository receipts covering the first two months in quarter to Collector. We advise making all three deposits and sending three depository receipts with quarterly returns to Collector. At any rate, be consistent. If you follow one method, stick to it.

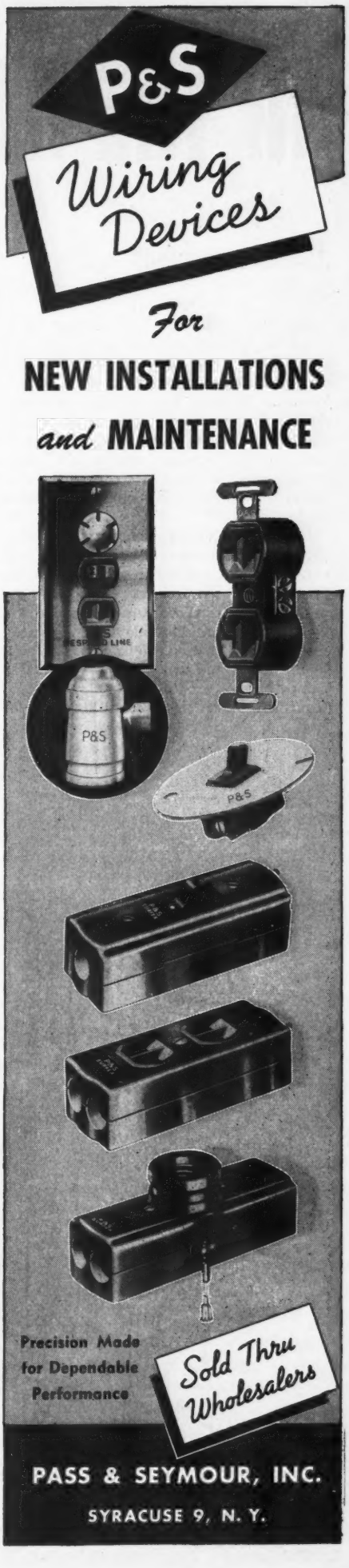
You may make out a form for each employee instead of putting all employee deductions on one sheet. This is easier when it comes to filling out Form W-2 telling each employee how much you deducted from his wages because you have the total on one sheet but it is more difficult to make up quarterly returns for the Collector because you must combine the totals on individual sheets, whereas, when combining withholdings for all employees on one sheet, you get the quarterly sum by adding up the figures. The contractor with a big personnel may find it necessary to procure special forms of this type from his stationer. The average contractor should be able to make up his own forms as shown here. The main thing to remember is that you should combine the tax deduction information on one sheet and not scatter it everywhere in the books. We show the headings to be put on such forms if you make them up yourself. Where the turnover of help is low and straight salaries paid or hourly wages run the same from week to week, the contractor will have little trouble computing deductions from week to week because he can refer to previous entries on the payroll sheet and get the exact figures in most cases. Where wages vary week to week, where payroll personnel is large, computations will take more time, but regardless of conditions, combine tax deduction recordings to save expense and avoid penalties.

Do not draw one check for payroll and post in total to the payroll account, a common practise before. Pay each employee by check, detailing deductions on a perforated stub, which the employee can tear off for his record. The employer's check stub should record the same information. In this way, employee and employer have a clean-cut record of the transaction to minimize subsequent controversy. Do not pay employees in cash. Your bank should be able to advise you where to get checks of the kind just described.

The payroll end of tax work involves more detail than ever before and your system must be "up to snuff" to do the work accurately. Every detail must be recorded for easy audit, quarterly payments to Collector, monthly deposits in bank, depository receipts, deductions, total wages and net wages paid. To guard against penalties, you should have a Tax Calendar showing the dates when returns are due and mailed.

Another aid is a "Tax File", in which place all receipts, duplicates of tax returns, and other data pertaining to tax. Do not depend on memory. Make a permanent record of all tax deductions in sufficient detail to be able to give a lucid explanation to government auditors.

QUAKER CITY electrical contractor leaders are (L to R) Ernie Hedler, manager, and Howard Miller, president, of Electrical Constructors, the NECA chapter and James C. Wolf, president of Enterprise Electric Company.



IN THE NEWS

ILLINOIS INSPECTORS CONVENE

An interesting and educational program of diverse subjects greeted more than 90 inspectors attending the 14th annual meeting of the Illinois Chapter, Western Section, International Association of Electrical Inspectors at the Hotel Sherman, Chicago, January 20–21. Subjects ranged from the mysteries of synthetic rubber to those of frequency modulation with plenty of basic code discussion in between.

Roger B. Kellogg, commercial wiring engineer, Commonwealth Edison Company, Chicago, started the first session by presenting a comprehensive study of the postwar electrical wiring field. Backed by charts of statistical data, he indicated the need for wiring adequacy, particularly in the home, and called for an aggressive campaign to promote adequate service facilities, branch circuits and flexibility of control in home wiring. T. L. Hankins, president, Cook County Electrical Contractors Association, outlined the birth of the curbstone contractor and suggested intensified vigilance of the electrical inspector and an aggressive program of reinspection in the industrial and commercial fields.

A comprehensive paper on grounding problems was presented by E. G. Elg, Copperweld Steel Co., outlining in detail the effectiveness of various grounding practices and test procedures. The theoretical concepts of static electricity, its potential hazard and practical methods of controlling it were related by J. A. Trovillo of Underwriters Laboratories, Chicago. W. M. Woll, heating engineer, Commonwealth Edison Company, reviewed the principles and applications of infra-red heating. Demonstration of some of the newer uses of fluorescent materials in combat craft was made by R. C. Hultgren, production engineer, General Luminescent Corp., Chicago. He also demonstrated a low voltage (400 volt operating), 8800 lumen, RLM type cold cathode fluorescent industrial fixture using four 8-ft. tubes with a safety disconnecting device which kills the fixture when lamps are renewed.

The ability of S. J. Rosch, manager, insulated products development, Anaconda Wire and Cable Co., to discuss industrial chemistry in a layman's language fascinated the audience as he unraveled the mysteries of modern synthetics. Particular emphasis was placed on those synthetics which may revolutionize the field of electrical insulations. The complex subject of frequency modulation in radio broadcasting was explained, through a clever analogy, by Ross Utter, chief engineer of the Zenith F.M. Radio Station in Chicago.

During the session on interim amendments and inspector's problems, the inspectors had the opportunity of firing a barrage of questions at V. H. Tousley and Roy Burgess who handled these subjects. Specific field problems of individual inspectors were aired and answered. A. R. Small, president, Underwriters Laboratories, reported that chances for the publication of a 1945 National Electrical Code were fairly good.

At the concluding business session the following officers were elected: chairman, Newton Moser, city inspector, Chicago; first vice-chairman, L. E. Ewald, inspector, Commonwealth Edison Co., Chicago; second vice-chairman, E. E. Dodds, city inspector, Chicago; third vice-chairman, L. Anslyn, inspector, Zion City, Ill.; secretary-treasurer, W. J. Alcock, Underwriters Laboratories, Chicago.

Members elected to represent the various branches of the electrical industry on the Executive Committee are: utilities—P. J. Markey, chairman; jobbers—E. M. Nelson; contractors—Emil DeHaan; manufacturers—R. S. Smith.

"What do you suppose they mean specifying a splashproof motor as a protection against drips?"

MILWAUKEE L-M GROUP VIEWS FUTURE

The electrical construction industry in Milwaukee is looking at the postwar field through the eyes of the Labor-Management Postwar Planning Committee of the Electrical Contractors Association, Milwaukee Chapter. This group, organized some six months ago, consists of eight members representing the Electrical Contractors Association and Local 494, IBEW.

Contractor committee members are Orville R. Nichols, A. C. Electric Co. chairman; E. H. Herzberg, manager,

NEW MITCHELL 4-LIGHT FLUORESCENT FIXTURE for Commercial Lighting

MODEL No. 2044
Uses Four 40-Watt Lamps

3 APPLICATIONS WITH ONE MODEL

Surface Mounting *Suspension Mounting*
Continuous Rows

EASY TO INSTALL

Just Slide on to Tracks

A matter of minutes to fasten each track to ceiling, slide and lock fixture in place. Takes less time and effort to install than any other fixture.

TWO TYPES OF TRACKS FOR CONTINUOUS ROW AND CEILING MOUNTING

Single track used when units are mounted individually.

Double track used where units join for end-to-end mounting.

Model No. 2044, using four 40 watt lamps, is the latest MITCHELL commercial fluorescent fixture, designed for use in offices, drafting rooms and other work areas. Provides cool, comfortable, economical lighting. Complies with latest WPB regulations — contains less than 6 lbs. metal. Single model offers every possible method of hanging — suspension mounting, surface mounting, individually or in continuous rows. Takes less time to install than other commercial fixtures because of new, simpler method of hanging. Metal "tracks" (furnished as standard equipment with each unit) are fastened to the ceiling with toggle bolts or Ackerman. Fixture simply "slides into place" on tracks. All-metal wireway channel and end pieces, finished in durable, high-gloss, chip-proof white enamel. Abundant knock-outs provided. Power Factor over 90%. Stroboscopic corrected. Underwriters' Laboratories approved. Unit is completely wired, ready for hanging.

MITCHELL FLUORESCENT

Get full details from your MITCHELL DISTRIBUTOR or write to

MITCHELL *Manufacturing Company*
2525 CLYBORN AVE. • CHICAGO 14, ILLINOIS

Electrical Contractors Association; B. H. Barg, B. H. Barg Electric Co.; and Harry L. Carlos, Holt Electric Motor Company. Labor representatives on the committee are John J. Daly, Charles Stenger, Rex Fransway, business manager, Local 494, IBEW; and Arthur C. Schroeder who is secretary of the committee.

The first committee action was to adopt substitute wiring methods and materials in the interest of greater conservation of materials for the duration. In the interim the members are carefully studying various pamphlets on postwar markets and planning that were released by such agencies as the National Resources Planning Board, the National Planning Association, the Committee on Economic Development and the U. S. Department of Commerce.

Recent committee action included the following:

1. Increased allocation of critical materials, as soon as feasible, to permit immediate employment of workers in the postwar era.

2. Consideration of the Postwar Report of the NECA-IBEW Labor-Management Committee.

3. The organization of an electronics school, in cooperation with a local vocational school, for both contractors and IBEW men.

4. The appointment of a subcommittee to gather information and data on prefabricated housing.

5. The study of means of developing closer cooperation between the distributor and the contractor.

6. The control of new apprentice placement to assure postwar jobs for 70 to 75 who are now in the armed services.

The construction industry through the Building Congress of Wisconsin, also has a voice in the Postwar Planning Committee of the Mayor of Milwaukee. E. H. Herzberg, manager of the Electrical Contractors Association is one of the Building Congress delegates representing the electrical contractors. The other is J. P. Gebhard, Gebhard-Berghammer, Inc., representing the general contractors.

Although no definite postwar blueprint has yet been drawn, the committee members are busy gathering data and when sufficient information is at hand, a definite program of action will be formulated.

ON HOME FRONT, Oliver Berry, electrical stores department, and Elmer Schwarz, electrical foreman, keep the wheels going at the St. Louis, Mo., plant of Anheuser-Busch Company.

K.C. CONTRACTORS CHOOSE GEISS

Members of the Greater Kansas City Chapter, NECA, at a recent meeting chose Fred E. Geiss as president of the group for the ensuing year. John Murray was elected vice-president and B. R. Nelson, treasurer. Members of the Board of Directors include: Fred E. Geiss, G. G. Burkholder, E. L. Fickie, W. M. Wachter and A. E. Smiley. G. V. Dameron is business manager of the group.

A. C. DUDREAR, estimator and engineer for I. B. Abel Son, electrical contractors of York, Pa. Al takes particular pride in pointing out that hi-voltage industrial distribution is old stuff to them but that each new job has its individual specifications and innovations to make them all interesting.

SAN FRANCISCO CONTRACTORS REELECT OFFICERS

Reelected for another year were the officers of the San Francisco Electrical Contractors Ass'n., Inc., at the annual meeting in January. George W. Abbett was reelected president for a third term, James Galvin, vice-president; Edward Scott, secretary; George Smith, treasurer. There were some changes in the directorate caused by resignations of some contractors who have closed up their businesses for the duration. Clyde L. Chamblin, chairman of the War Savings Bond Bureau of the Association and IBEW No. 6, reported that $290,700 in War Bonds had been purchased by contractors and their electricians through

CONSTRUCTION - MAINTENANCE is an old term to W. A. Flur, (left) maintenance electrician, Cutler-Hammer, Inc., Milwaukee; and H. D. Just, B. H. Barg Electric Co., Milwaukee contractor, who are discussing mutual problems at a recent Electrical Maintenance Engineers meeting.

the bureau in its year of operation. A gift and a testimonial of thanks were presented to G. Walter Spencer, past president, upon his retirement from business to go into farming. Spencer was president during the days of the formation of the bid depository and also served as chairman of the committee administering that independent organization.

MILWAUKEE RENEWS ELECTRICAL TRADE SHOW

After a two-year lapse, the Electrical Maintenance Engineers of Milwaukee held their 5th Annual Industrial Electrical Exhibit on February 3, 4 and 5, in the Public Service Building auditorium. Last year, because the manufacturers were completely absorbed in reaching peak war production schedules, the association decided to skip the show. This year, however, since manufacturers can devote some thought to eventual return to civilian production and the postwar markets, the concensus of opinion was in favor of a show.

Because most of the newest developments in electrical equipment, particularly electronic controls, etc., are clothed in military secrecy or are still pretty much in the experimental stage, there was an appreciable lack of startling exhibits. Conspicuous by their absence were industrial electronic controls and the much discussed cold cathode fluorescent lighting.

Some 40 electrical manufacturing and sales organizations occupied booths and exhibited the latest refinements in standard electrical equipment and accessories, covering practically the entire field of electrical construction and maintenance. Exhibits naturally fell into three distinct categories: construction materials—wire and cable, bus duct, conduit fittings, connectors, motors, switches and controls of standard, weatherproof and explosion-proof types; lighting equipment—commer-

Where DEPENDABILITY COUNTS...

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SHIPBOARD CABLES

Leaded or Non-Leaded
Synthetic or Varnished Cambric Insulation
In accordance with Specification AIEE-45A and USMC Design Memo #46

Ask your local Distributor for prices and deliveries that you can rely upon.
WALKER BROS., Conshohocken, Pa.

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- "Preset-Inserts" Underfloor Distribution Systems
- "Dualcote" Rigid Steel Conduit
- Electric Metallic Tubing
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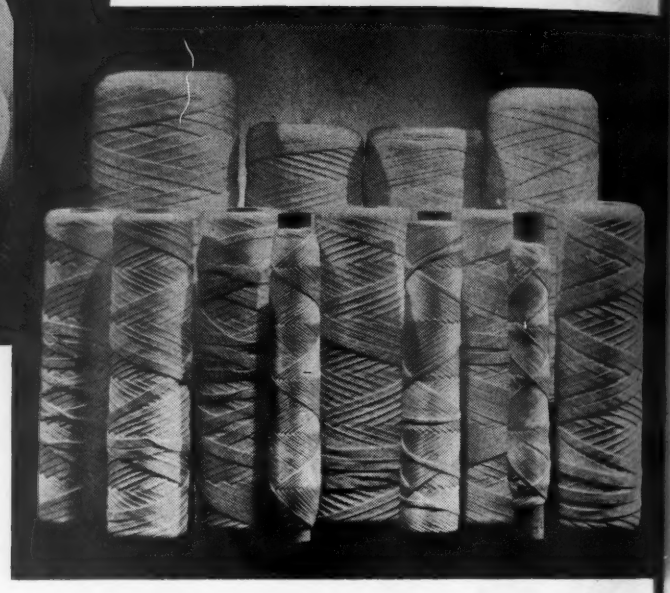
- "Walkerflex" Non-Metallic Sheathed Cables
- Service Entrance Cables
- Automotive Wires and Cables

WALKER of Conshohocken

FIBERGLAS* ELECTRICAL INSULATION

Fiberglas Tapes available in all widths and thicknesses from .003″ to .015″.



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Leo J. Meyberg Co., Inc.
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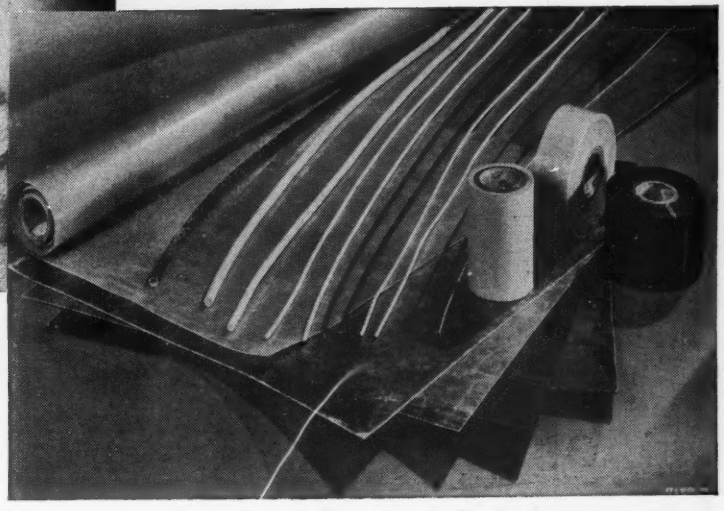
Increased Fiberglas Production permits this Announcement to be Made.

Fiberglas Tying Cords both treated and untreated.



A few of the many types of Fiberglas fabricated materials, including Fiberglas cloths, tapes, and tubings; Fiberglas-mica combination material and Fiberglas laminated sheets.

Not pictured but also available are: Unprocessed yarns, varnished tapes, cloths, sleevings, and saturated sleevings.

Owens-Corning Fiberglas Corporation, Toledo 1, Ohio.
Fiberglas Canada, Ltd., Oshawa, Ont.

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*T. M. Reg. U. S. Pat. Off.
ELECTRICAL INSULATION

ARMY (E) NAVY

Fiberglas Materials are in stock for immediate delivery!

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Mitchell-Rand Insulating Co., Inc.
51 Murray Street

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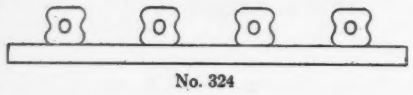
Electric Specialty Co., Inc.
2406 First Avenue

TRAFFORD, PA.
Westinghouse Electric & Mfg. Co.
Micarta Div.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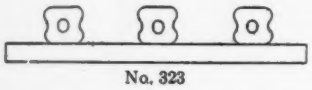
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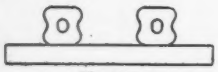
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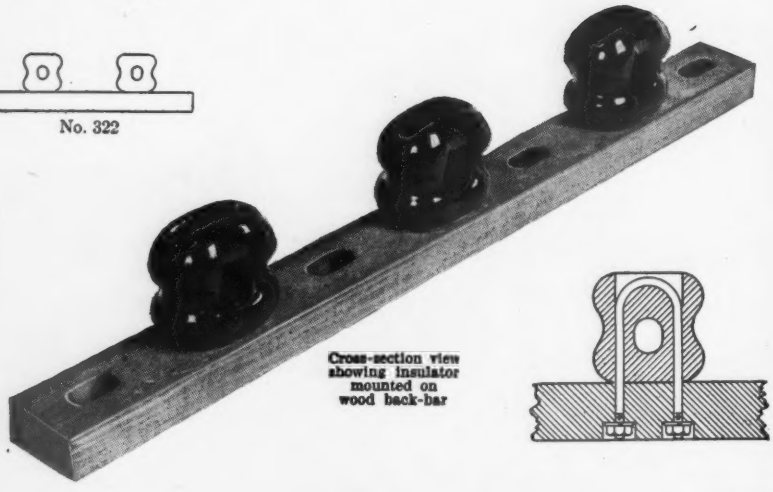


YOU WILL LIKE

THESE BETTER WOOD-BACK RACKS

Required By Army Construction Specifications

Wood-back Racks, a war-time development, are proving far superior to their peace-time predecessors in many respects. They provide maximum safety because they are made almost entirely of insulating materials. They are lighter, easier to handle and have equal, or superior, performance characteristics than similar metal racks. Made of tough hardwood, treated with a permanent toxic water repellant wood preservative and with insulators securely fastened, they will last indefinitely. Wood-back racks are in service on thousands of jobs throughout the United States. Order today from your Electrical Jobber.

FOR NON-METALLIC WIRING CONSTRUCTION

Porcelain Outlet Boxes

Surfolets

PORCELAIN PRODUCTS, Inc.

FINDLAY, OHIO

cial and industrial fluorescent of standard and dust-tight type, heat lamps, combination mercury-mazda units for high and low bay mounting, etc.; and maintenance tools—air filtering equipment, materials handling equipment and a host of other items that interest the maintenance man.

Among the exhibitors were two Milwaukee electrical contractors, Dietz Electric Co., and the Staff Electric Company; also two electric motor service shops, Holt Electric Motor Company and Trester Service Electric Company, in addition to the General Electric and Westinghouse Service shops.

One U. S. Rubber Company exhibit although not of an electrical nature, attracted considerable attention and gave a wartime flavor to the show. That was a four-man rubber life raft similar to those used by our air men in combat flying.

The highly successful show closed with the annual dinner dance of the Electrical Maintenance Engineers on February 5.

C.L.I. ELECTS OFFICERS

Two vacancies in the officialdom of the Chicago Lighting Institute, created by the death of John G. Learned, vice-president of the Public Service Company of Northern Illinois, were filled at a recent meeting of that organization. A. H. Meyer, manager, midland sales district, lamp department, General Electric Company, was elected to serve as vice-president of the Institute and represents the General Electric Company on the Board of Directors of the Chicago Lighting Institute.

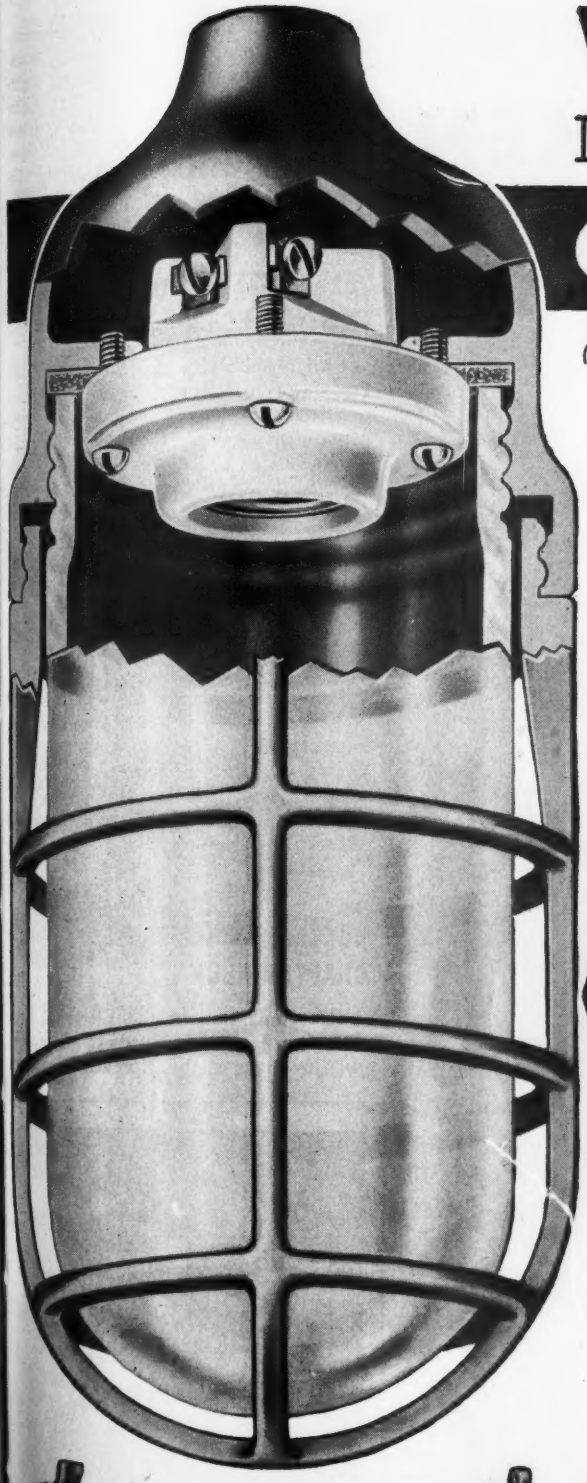
A. H. Schneider, general sales manager, Public Service Company of Northern Illinois, was appointed by his company to represent them on the Institute Board of Directors—a position also held by the late Mr. Learned.

Other Institute officers reelected include: president, Ralph G. Raymond,

CORNER CONFAB finds M. F. McCann, (left) electrical department general foreman, U. S. Rubber Co., Milwaukee; and E. H. Grieb, district manager of the Holophane Company discussing plant lighting at a recent Milwaukee E.M.E. meeting.

Vaportight
Industrial Lighting
CONDULETS

(CONDULETS are manufactured only by CROUSE-HINDS)



For boiler rooms, shower rooms, powerhouses, tunnels, docks, building entrances, and all indoor or outdoor locations where exposed to vapors, moisture, rain, smoke, or non-explosive dust and gas.

Vaportight and raintight.

Wiring chamber remains vaportight even though globe is off.

Screw guard or clamp guard types.

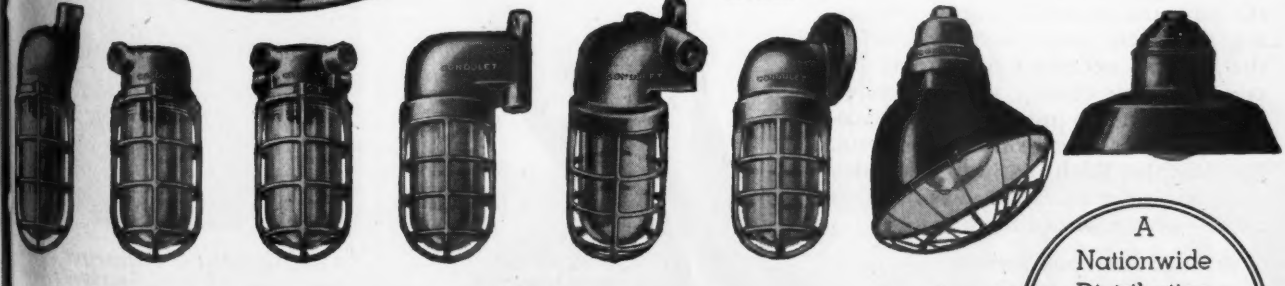
12 Hub arrangements.

4 Reflector styles.

Accessories: colored globes, guards, half shades, adapters.

4 Sizes: 50 through 500-Watt.

Other ***Vaportight*** lighting fixtures are available for attachment to many round-base Condulets and sheet steel outlet boxes. Crouse-Hinds complete ***Vaportight*** line includes hand lamps, switches, plug receptacles, and other electrical devices.



A Nationwide Distribution Through Electrical Wholesalers

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CROUSE-HINDS COMPANY OF CANADA, LTD., TORONTO, ONT.

LINEMEN ARE KLEINMEN
IN THE SERVICE AND OUT

Back home, one contribution we can make to speed Victory is the conservation of tools and equipment. To help in this important job, Klein has prepared an illustrated pocket manual on the care and correct use of tools to assure their long life. A copy will be sent to anyone interested.

Today Klein Pliers are winning new friends among men whose tough jobs make quality pliers a necessity. When they return to peace-time occupations, many thousands of men who are in the armed forces, or who are engaged in the manufacture of war material, will have the same high regard for Klein tools that good workmen everywhere have had for almost a century.

Meeting the demands of the Army, the Navy and essential industry is keeping the Klein plant busy, producing the tools so necessary to victory. No conversion or change will be needed to transform this production to peace-time needs as soon as the war is won. For Mathias Klein & Sons are today producing the tools they have always made—only more of them.

ASK YOUR SUPPLIER

Foreign Distributor:

International Standard Electric Corp., New York

Since 1857

KLEIN TOOLS EST. 1857

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

manager, of electricity sales, Commonwealth Edison Company; secretary-treasurer, G. K. Hardacre, manager, lighting sales of the Public Service Company of Northern Illinois; and assistant secretary-treasurer, Carl W. Zersen, manager of the Chicago Lighting Institute.

REAPPOINTED TO STATE BOARD

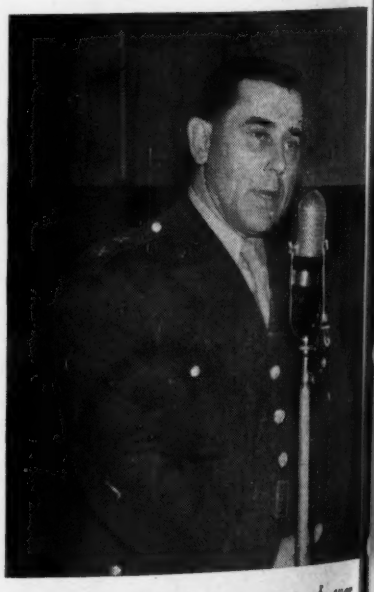
Two members of the Minnesota State Board of Electricity were reappointed by Governor Thye for five-year terms beginning January 1, 1944. They are George M. Jones, Industrial Electric Co., Minneapolis; and R. C. Condon, superintendent, Municipal Utility at Shakopee, Minnesota.

SCHORR HEADS COMMONWEALTH ELECTRIC

Paul Schorr, Sr., was recently elected president of Commonwealth Electric Co., enterprising St. Paul, Minn. electrical contracting organization. Mr. Schorr, who was vice-president and in charge of electrical construction, succeeds J. M. Whalen who has retired.

NORTHERN CALIFORNIA CHAPTER NECA

Reorganization of the Electrical Contractors Assn. of Northern California, Inc., to make it the Northern California



THE GREATEST instrument of war and peace is man, reiterated Major-General L. S. Hobbs, Commanding General, 30th Infantry Division, U. S. Army, as he adressed more than 1000 production men at the recent War Production Clinic at Indianapolis. Some 200 maintenance electricians later adjourned to review electrical maintenance problems at a panel discussion.

Because they hang it on the Ceiling

Here's an electrostatic air cleaner that is hung from the ceiling. The very act of hoisting it up there, regardless of all the other advantages gained, just naturally calls for the light weight of aluminum. (Speaking postwar, of course, though it's none too early to be doing this kind of Imagineering.)

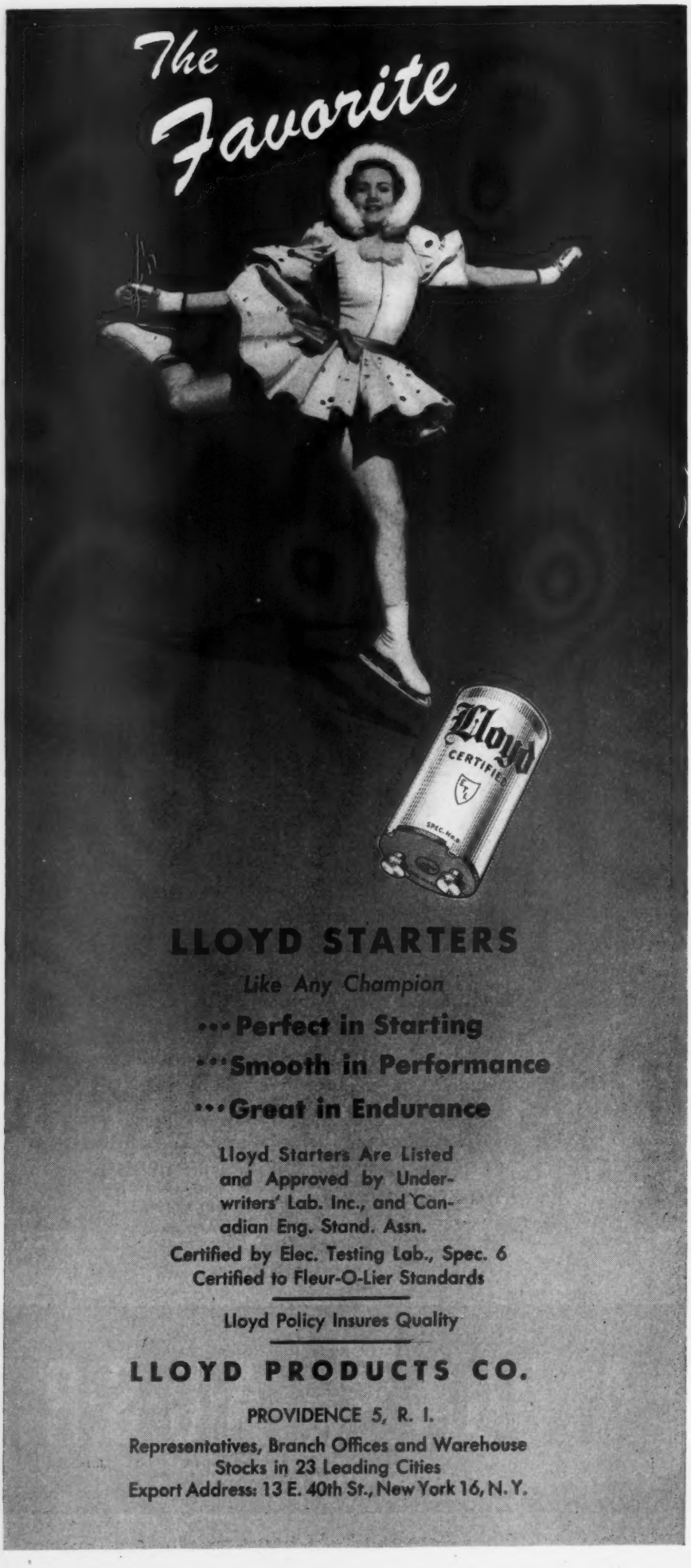
And, if it were made of lightweight Alcoa Aluminum, think how much lower a load you'd be placing on the building. Perhaps much wider markets could then be uncovered for this device in places where weight is still more of a deciding factor.

Add the fine appearance of aluminum and its ability to resist corrosive atmospheres, the high electrical and thermal conductivities of aluminum, and its nonmagnetic property. What a list of reasons for considering aluminum for many electrical devices!

Put your products in place of this one, and figure what Alcoa Aluminum will do for them. Alcoa engineers will gladly help you weigh these reasons against what you wish to accomplish. Write ALUMINUM COMPANY OF AMERICA, 2197 Gulf Building, Pittsburgh, Pennsylvania.

IMAGINEERING AT WORK

ALCOA A·C·S·R


The Favorite
Lloyd
CERTIFIED
LLOYD STARTERS
Like Any Champion
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•••Smooth in Performance
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Lloyd Starters Are Listed and Approved by Underwriters' Lab. Inc., and Canadian Eng. Stand. Assn.
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PROVIDENCE 5, R. I.
Representatives, Branch Offices and Warehouse Stocks in 23 Leading Cities
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Chapter, National Electrical Contractors Ass'n., Inc. was officially effected Dec. 30 at a special meeting in San Francisco. With reorganization came a new financial policy and the establishment of a new office in the Western Merchandise Mart, 1355 Market St., San Francisco, in collaboration with that of the western field representative of NECA, W. J. Varley. Officers elected for the chapter are T. L. Rosenberg, Oakland, president; Ed Pierce, Vallejo, vice-president; W. A. Cyr, secretary-treasurer; and as directors, George W. Abbett, San Francisco; Wesley Evans, Salinas; Seth Cohn, San Mateo; J. D. O'Connor, Sacramento; Roy Butcher, San Jose; T. M. Robinson, Fresno; Tom Drury, Bakersfield; Grover Grider, Stockton.

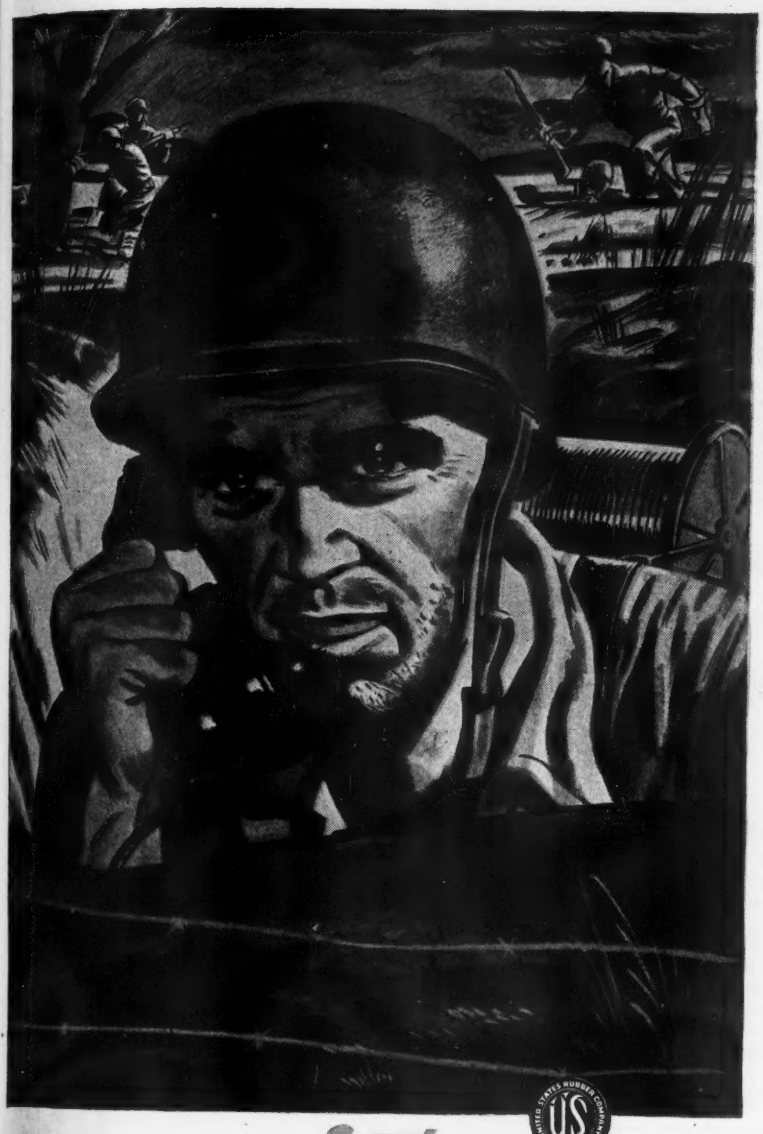
MONTGOMERY HEADS MINN. STATE BOARD

J. C. Montgomery was elected president of the Minnesota State Board of Electricity at the recent annual election of officers of that organization. William Boland was chosen vice-president and Richard Condon, secretary-treasurer. George Garney continues as Executive Secretary of the Board.

ST. LOUIS E.C.A. ELECTS OFFICERS

At the annual meeting of the Electrical Contractors Association, St. Louis Chapter, NECA, held January 11, the following officers were elected for the year

***ELECTRICAL MAINTENANCE** is the vocation of these two chief electricians in vital war industries. P. P. (Patty) Hackett (left) keeps the electrical system at American Steel Foundry, Granite City, Ill., in A-1 condition while J. A. Wild has a similar responsibility at Manufacturers Railway Co., St. Louis, Mo.*



PIPE LINE TO VICTORY

Up ahead the cluster of houses where the enemy had holed in crumbled. You could see the rubble flying high in the air and before the dust had settled could see other shells hit the mark.

Hunkered down in a shell hole, the observer pressed his lips closer to his phone's mouthpiece. "On target," he said . . . and his words went back across the rough terrain to the battery . . . came through clearly, distinctly.

That's because Laytex Assault Wire . . . made expressly for front line service . . . has a talking distance of better than five miles. It is a positive means of assuring clear, sure transmission of messages from reconnaissance posts to headquarters.

But talking distance is not the only advantage of Laytex Assault Wire. Its superior insulation makes possible its small diameter and light weight; a mile weighs less than 30 pounds. It has high resistance to moisture—can be unreeled over wet ground, through puddles and streams without affecting its efficiency. It is unaffected by temperature changes and does not become embrittled by concussion and shock

These same properties—light weight, small diameter, ability to withstand temperature changes, flexibility and toughness make other types of Laytex Wires and Cables as important in peacetime industry and building as to the Armed Forces.

Laytex **ASSAULT WIRE**

ON THE JOB IN ANY CLIMATE. Laytex Assault Wire was developed by United States Rubber Company scientists working in close cooperation with engineers of the Army Signal Corps.

LIGHT WEIGHT SAVES MANPOWER. One man carries enough wire to keep communications open. This is important—it not only releases men for other duties but also reduces the fatigue of men who are travelling hard and fast.

TALKING DISTANCE...OVER 5 MILES . . . Laytex Assault Wire assures clear, sure transmission of messages—a prime military requirement for battlefront communications.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

SERVING THROUGH SCIENCE TO BUILD A BETTER WORLD

UNITED STATES RUBBER COMPANY

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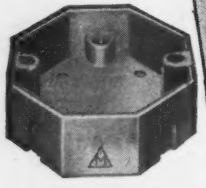
ILLINOIS

Completely Insulated

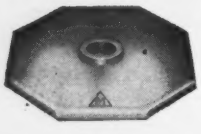
ALL PORCELAIN WIRING SYSTEMS

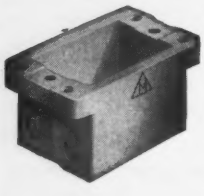
for HOME, COMMERCIAL AND INDUSTRIAL WIRING *Conserve* STEEL, ZINC, COPPER, RUBBER



OUTLET BOXES

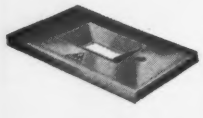
Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knock-out holes and mounting screws. High mechanical and electrical efficiency.





SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of best quality white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plugs, outlets, etc. Knockouts for single wires, also for cables. Specify and use them.



STANDARD TUBES

In sizes ½ to 48 inches, 5/16- to 3-inch diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved end, cross-over split, and cross-over. Diameters all uniform both inside and outside.

KNOBS

Cement coated — nail — genuine leather-washer — code standard. They don't chip when driven in and they stay in place.

TOGGLE SWITCH PLATE

All porcelain with beveled edge and decorative pattern on face.

CLEATS

Standard one, two, and three-wire types.

● Not only because porcelain saves vital materials is it valuable today but because these systems give you highest standards in results and offer your customers permanent wiring. Porcelain systems are safe, easy to install, and adaptable to practically all wiring plans and layouts. Grounding is unnecessary. No rusting or corrosion. Install ILLINOIS All Porcelain Wiring Systems the next time you have a wiring job.

TRADE MARK Bull Dog REGISTERED

Look for this Trade Mark

ILLINOIS ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

1944: president, Sam Sachs; vice-president, Fred Rick, treasurer, Ed. Mueller.

Members chosen to be Directors of the Association include: E. O. Dorsch, Carl I. Schaffer, Ed. Mueller, Fred Rick, Paul Wendt and Sam Sachs. Cary H. Christine was reappointed secretary and Russell E. Vierheller was reappointed business manager of the Chapter.

COMING MEETINGS

North Central Electrical Industries—Second Electrical Industry War Conference, St. Paul Hotel, St. Paul, Minnesota, March 26-28 inclusive.

National Industrial Service Association, Inc.—Annual Conference, Netherlands Plaza Hotel, Cincinnati, Ohio, April 12-13.

National Electrical Contractors Association—General Meeting, Jefferson Hotel, St. Louis, Mo., April 15-16.

National Electrical Wholesalers Association—Second Annual War Conference, Stevens Hotel, Chicago, Ill., April 19-22.

National Electrical Manufacturers Ass'n.—Spring Meeting, Palmer House, Chicago, Ill., April 24-27.

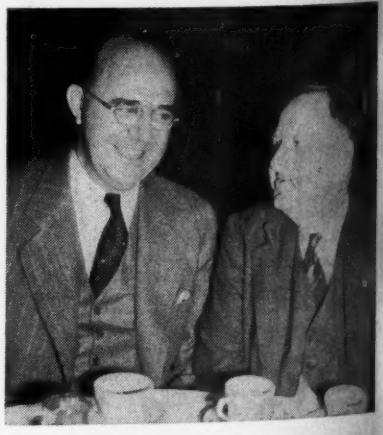
National Fire Protection Ass'n.—Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., May 8-11.

American Institute of Electrical Engineers—Summer Technical Meeting, Jefferson Hotel, St. Louis, Mo., June 26-30.

National Electrical Manufacturers Association—Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y., October 23-27.

INDIANAPOLIS REPEATS PRODUCTION CLINIC

Arsenal Technical High School, Indianapolis, Indiana, was the scene of a repeat performance of last year's successful War Production Clinic—an idea clinic sponsored by the combined engineering groups in cooperation with the War Productin Board. More than 1200 representatives of industrial plants in the



FAR AFIELD was Stanley Cameron, vice-president of Foley Electric Co., of Philadelphia, when he attended the Eric Johnston dinner in San Francisco. With him is Charles Dean, Westinghouse circuit breaker expert, San Francisco. Cameron had just been to Geneva, Utah, to look over the part of the DPC-Columbia Steel plant which his company is installing. Several electrical contracting firms are working on different parts of that project.

"LIGHT LINE" TO VICTORY

• Long rows of industrial fluorescent units—flooding large factory areas with well-diffused light—help speed victory because they enable the war worker to see better and therefore produce more with less scrap.

• Today, of course, metal fixtures are not available for fluorescent lighting. That's why so many manufacturers are using the new, non-metallic Masonite* Reflector Shapes.

• Yes, manufacturers are finding that reflectors made of this rugged but surprisingly light-weight material have many very definite advantages. They're extremely easy to handle—cut shipping costs. They can be installed quickly and serviced simply. They will not rust—even in high humidity locations such as laundries and over plating tanks!

• You'll want to know more about the properties of Masonite Reflector Shapes because you'll be seeing more and more of them—in war factory today, in post-war factory tomorrow. For complete details, please write Masonite Corporation, 111 W. Washington St., Chicago 2, Illinois.

MASONITE CORPORATION

*TRADE-MARK REG. U. S. PAT. OFF.

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Accurate – Uniform – Automatic!

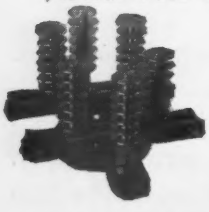
IDEAL COIL WINDING EQUIPMENT

Coil Winder Drive

Assures uniformly wound, perfect coils. Speed is infinitely variable from 90 to 500 RPM; Automatic Counter accurately shows number of turns. Output torque 350 to 60 inch lbs. depending upon speed.

FOR USE WITH ALL TYPES OF COILS AND ARMATURES

IDEAL COIL WINDER HEADS



"Universal" Model, flexible — winds perfect coils ranging in size from 3¼" x 6½" up to 13 x 16½". Wound from one wire—no soldering.

IDEAL ARMATURE WINDING HEAD

Adjustable to accommodate armatures up to 3" in diameter with 2¼" maximum armature stack. Easy to set up.

IDEAL INSULATION TESTER

Quickly indicates the presence of "shorts," "grounds" or broken wires in low-voltage equipment, such as motors, transformers, etc.

Write for Detailed Information

IDEAL *Sycamore*

• IDEAL COMMUTATOR DRESSER CO •

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Sales Offices in All Principal Cities

In Canada: Irving Smith, Ltd., Montreal, Quebec

Indianapolis area journeyed to the school campus on January 14 for a one night session devoted to a general exchange of ideas developed throughout the past year —a give and take spirit that had as its goal the intensified development of all resources for total war.

Men with the "know how" of production and maintenance—production men, shop superintendents, foremen, setup men, engineers and maintenance men attended panel symposiums covering specific fields in which they were engaged. In all, ten discussions reviewed the following subject problems: machine shop; tool making and tool design; presswork and deep drawing; metallurgy and heat treating; electroplating and finishing; welding; maintenance; foundry problems; manpower conservation through safety; production planning and scheduling. Individual panels were conveniently subdivided into related subjects with industrial specialists in each field leading the round-table discussions.

The general panel on maintenance problems was divided into three separate symposiums—general maintenance of buildings and grounds; machine repair and maintenance; and electrical maintenance panel, sponsored by the Electric League of Indianapolis, drew an audience of some 200 plant electrical maintenance men, engineers, motor service men and manufacturers representatives. The comprehensive program followed the question-and-answer pattern with a board of seven experts taking on all comers.

J. Webb, electrical engineer, Eli Lilly and Co., was discussion leader and general referee directing the questions to the proper experts for answers. The down-to-earth practical experiences related during the symposium provided the audience with the information it sought. Members of the group of experts included the following plant chief electricians: J. H. Ferguson, Lukas-Harold Corp.; C. C. Taylor, Allison Division, General Motors Corp.; P. L. Ritter, Bridgeport Brass Co.; H. T. Fox, U. S. Rubber Company. Other members on the board were R. M. Brown, director of lighting sales division, Indi-

JAMES B. BLACK, president of Pacific Gas and Electric Co., San Francisco, and Eric Johnston, president of Brown-Johnston Electric Co., electrical contractor of Spokane, Wash., who has achieved world eminence as the youngest, most progressive president the U. S. Chamber of Commerce ever had.

EVERY PHASE of electrical maintenance and repair work covered in this library

5 volumes of practical how-to-do-it information

Every man concerned with the care and repair of electrical machinery should have these practical books, with their helpful tables, diagrams, data, methods and kinks. Every one of the five volumes is jammed to the covers with sound, how-to-do-it information—the kind you have to have when anything goes wrong. Liberal use has been made of practical data and practice in repair shops so as to combine the good features of a library of methods with handbook information covering these methods.

Electrical Maintenance and Repair Library

2042 pages, 1721 illustrations and diagrams

These books show you how to

—install all types of motor and generator units;
—locate breaks in armature windings and do a workmanlike job of rewinding;
—know just what is wrong with an electrical machine and take charge of installation and maintenance work;
—make accurate tests of switchboards and apparatus and correctly balance the power with the load;
—handle every sort of wiring job;
—show competence whether it be in the use of a Stillson wrench or a Wheatstone bridge.

Includes trouble-shooting book

Now, in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a book giving helpful maintenance information, special trouble-shooting charts, explanation of symptoms and causes of machinery trouble, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

10 days' examination
Easy monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

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Send me Electrical Maintenance and Repair Library, 5 volumes, for 10 days' examination. If I find the books satisfactory, I will send you $1.00 in 10 days, and $3.00 a month until $15.00 has been paid. Otherwise I will return the books postpaid.

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Position ..... EC. 3-44

THE SCENE: Lighting Conference

THE VOTE: MILLER Fluorescent–Unanimous

Lighting meetings like this have happened many times in the past in many a busy war plant—will happen many more times during crucial 1944. Inevitably the vote goes, hands down, to MILLER 50 & 100 FOOT CANDLERS, and here's why . . .

PLANT MANAGER—"We still have stiff production quotas to meet—with greener help. MILLER 50 & 100 FOOT CANDLERS will give us 30, 40, 50 or more foot candles of illumination—and that's what we need for better, faster production."

WORKER—"Sounds good to me. I've worked under MILLER fluorescent and I know I've worked better and felt better simply because I could see what I was doing at all times clearly and sharply."

MAINTENANCE MAN — "Those lightweight Masonite reflectors MILLER uses will take plenty of punishment, and yet a girl can handle their cleaning. I like the exposed ballasts because they mean cooler operation. And I go big for that MILLER Patented Safety Lamp Lock that keeps lamps from falling."

ELECTRICAL CONTRACTOR — "I can handle the installation of MILLER equipment in less time, shorthanded as I am for trained help. Units go together easily into self-aligned runs. Hanging is simplified. I've had MILLER jobs result in installation savings of 30 to 50% to owners."

ARCHITECT — "I've specified MILLER Continuous Wireway Fluorescent Lighting Systems on both new construction and modernization projects. The beauty of it is its flexibility. Whole sections, or even the entire system can readily be moved to other parts of the plant."

UTILITY ENGINEER — "From power source right through to controls, the whole MILLER setup saves considerable critical material—and provides an adequate, modern lighting system . . . something we utility guys have been preaching for years."

OWNER — "You fellows hit both my pocketbook and my patriotism. I say let's specify MILLER 50 & 100 FOOT CANDLERS—and let's get a MILLER field man in pronto to talk turkey."

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

MILLER
SINCE 1844

DO IT FASTER WITH Thor

STAR DRILLING like this is fast and sure with the Thor Portable Electric Hammer—for drilling and hammering in stone, wood or metal.

• Thor Portable Electric Tools combine compact power with light weight to do scores of jobs *faster.*

For example—Thor *reduced the weight* of ¼-inch electric drills 14 percent with plastic housings.

Thor *increased the power* of electric hammers with a patented "sling-shot" drive.

Thor introduced *compact power* with the original, close-coupled half-inch electric drill.

The features of greater power with easier handling combine to give you *more efficient performance* with Thor Portable Electric Tools for all types of light and heavy duty drilling, screwdriving, reaming, nut setting, tapping, grinding, sanding, polishing, sawing, metal cutting and hammering.

SANDING and finishing preparatory to painting, with an easy-handling Thor Electric Sander, perfectly balanced for efficient operation.

OUTSTANDING THOR FEATURES OF DESIGN AND CONSTRUCTION

Thor Motor

THOR MOTORS are fabricated of the highest grade materials, with armatures carefully wound and insulated to withstand heat and vibration. Commutators are assembled with special care to avoid floating segments or raised bars.

Thor Gears

THOR GEARS are made of heat treated alloy steel with oversize pitch to assure smooth operation and longer life.

THOR VENTILATION of the tangential type provides 25% greater cooling capacity.

Thor Bearings

THOR BEARINGS of the highest grade, are mounted in cast-in steel inserts and diamond bored to assure perfect alignment.

NEW HELP FOR YOU IN SELECTING ELECTRIC TOOLS

Just off the press, the latest edition of Thor Portable Electric Tool Catalog is packed full of information on the selection of proper tools for your work. 64 pages of complete specifications, performance data, construction features . . . arranged for quick and easy reference and fully illustrated.

PORTABLE ELECTRIC TOOLS

ASSEMBLING parachute flares with Thor Portable Electric Screwdrivers, light weight favorites of women operators.

SETTING NUTS with a large capacity, heavy duty Thor Electric Nut Setter, easy to handle . . . insuring quick, certain operation.

GRINDING down a weld with a Thor Portable Electric Grinder saves handling time by bringing the tool to the work—instead of the work to the tool.

DRILLING with the Thor original close-coupled half-inch portable electric drill, compactly built for fast work on heavy jobs.

Thor *Portable Electric Tools*

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. JACKSON BOULEVARD, CHICAGO, ILL.

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PATRONIZE YOUR DISTRIBUTOR

Thor Portable Electric Tools are stocked and sold by leading electrical, automotive, mill supply, plumbing and hardware distributors throughout the world. This guarantees you quick, convenient, reliable service. Write for name of distributor nearest you.

FAN PARTS!

★ NOW IS THE TIME TO ★
OVERHAUL YOUR FANS

Fan Parts in Stock for

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★ *No Priorities Required* ★

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E·M·T CONNECTIONS IN A FEW SECONDS!

With B. M. Fittings

TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job!

(All B-M Fittings carry the Underwriters Seal of Approval)

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Prompt Deliveries on Properly Rated Orders

BRIEGEL METHOD TOOL CO. • Galva, Ill.

anapolis Power & Light Co., who handled the lighting queries; and M. F. Stigers, professor, department of education and psychology, Purdue University.

In outlining the three "C's" of maintenance—Cause, Cost and Control—Professor Stigers related that workers who are free of grievances are much more apt to take care of the equipment they operate. Another psychological point that he made was that workers should be apprised of the true cost of repairs, both from the monetary and lost production viewpoints, thus giving them an appreciation of the value of the equipment they are operating and the work they are doing. Maintenance of good discipline to prevent accidents and equipment damage through horseplay; safety rules; good housekeeping; and a well trained and alert supervisory staff are other important factors in maintenance control, he concluded.

One interesting sidelight on this electrical maintenance panel is that out of last year's Clinic grew the present electrical maintenance engineer's division of the Electric League of Indianapolis. Based on the success of that panel, regular monthly meetings of the group were held during the year with the resultant growth of the division and interest in its activities.

FRANK BOYD HEADS PACIFIC ELECTRIC MOTOR CO.

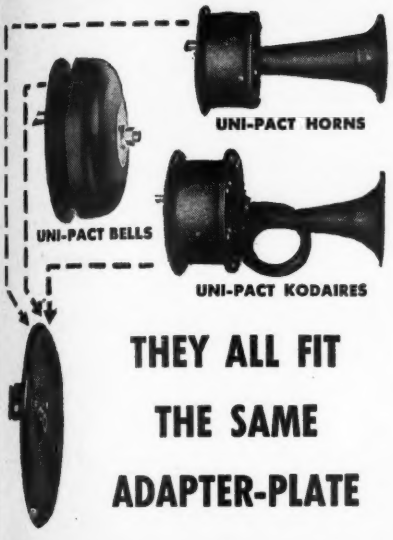
Pacific Electric Motor Co., of Oakland announced changes to its management owing to the death of Walter D. Vance, its president. His partner, Frank E. Boyd becomes president, Mrs. Lina K. Vance, widow of Walter D. Vance, vice president; W. D. Vance, Jr., Secretary-treasurer, and G. R. Duncan, executive engineer in charge of engineering and sales. The company does a large motor, industrial and wiring business in northern California.

W. W. HANKS, President of Southern Electric Service Co. Inc., Charlotte, N. C. is expanding the facilities of his already large repair shop. It is hoped that the additional space will alleviate to some extent the pressure of increased volume in repair work.

A perfect answer for every Signal Problem

SCHWARZE FARADAY

AUDIBLE ELECTRIC SIGNALS



THEY ALL FIT THE SAME ADAPTER-PLATE

The Famous Interchangeable *Uni-Pact*

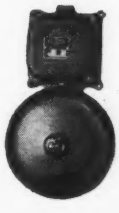
saves time, labor, equipment

• You'll find it easy to arouse enthusiasm among your trade for this outstanding development in signal design—because it enables the user to switch instantly to the type of signal he wants, *with only one outlet.* Bell, Horn, Kodaire—all three can be plugged into the same adapter plate, saving time, maintenance and equipment costs. Key your selling efforts to this striking example of efficiency and economy in industrial signals.

DEPENDABLE SIGNALS FOR ALL YOUR CUSTOMERS' NEEDS

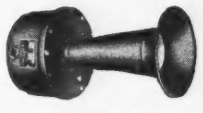
KODAIRES

• Industry's finest all-electric air-blast signal. Serves the heavy-duty purpose of coding and general alarm use with high power and complete dependability. Illustration shows weatherproof style.



BELLS

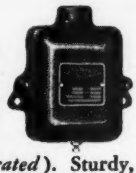
• All types for every conceivable need are described in the Schwarze-Faraday Catalog (see below). Illustration shows the Standard, Heavy Duty, Vibrating Plunger Neck Type, made for A.C. or D.C.



HORNS

• Illustration shows Standard Weatherproof Horn for outdoor use. Heavy duty, vibrating type. Made in Megaphone or Two-Way Projector styles. For A. C. or D. C. (as are most Schwarze-Faraday signals).

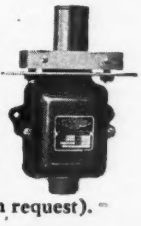
BUZZERS



• Heavy duty, highest quality. Illustration shows Standard Adjustable Type, with coils especially impregnated for outdoor use.

• **SIRENS** (*not illustrated*). Sturdy, dependable, weatherproof, motor-driven industrial type with penetrating, attention-getting shrillness.

CHIMES



• Clear, pleasant tones. Advanced design, completely dependable under all conditions. Xylophone bar and resonator type. Heavy duty, easily installed (loudness ratings of all signals are shown in the general catalog—free on request).

AIR TRUMPETS

• Maximum power signals that overcome distance and high noise levels. Provided in complete operating units ready for connection to power circuits.

Send today for a FREE copy of our complete, illustrated, fully indexed catalog

SCHWARZE ELECTRIC COMPANY

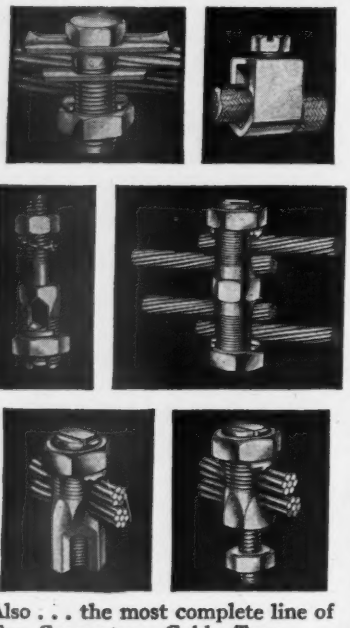
ADRIAN, MICHIGAN

"All SIZES of SERVICE CONNECTORS—

from No. 10 to 1,000,000

and All TYPES"

You can find exactly the service connector you need, in the Penn-Union Catalog: Yoke-and-Nut type, in a complete range of sizes . . . Service Entrance connectors . . . Service Post and Special connectors in wide variety.



Also . . . the most complete line of Tee Connectors, Cable Taps . . . Straight, Parallel, Elbow and Cross Connectors . . . Bus Supports, Clamps, Spacers . . . Grounding Clamps, Terminal Lugs . . . practically every good type.

Leading utilities, industrials, electrical manufacturers and contractors have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.* Write for the Penn-Union Catalog.

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

GEO. F. MOTTER is the present sec'y-treas. and general manager of Geo. F. Motter's Sons, York, Pa., who has a large motor repair shop and does a land-office business in industrial and electrical maintenance. George is very active in civic affairs, is a director of the Y. M. C. A., Rotary Club member, and immediate past president of the York Foreman's Club. John C. Motter, president of the company is also president of the York Chamber of Commerce.

WINTER HEADS MOTOR SERVICE GROUP

Paul G. Winter, American Electric Company, Indianapolis, Ind., was recently elected chairman of the motor service shop division of the Electric League of Indianapolis, Inc. He was also chosen a member of the Board of Directors of the League.

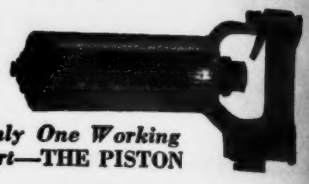
FOND DU LAC CODE AMENDED

A recent amendment to the municipal electrical code of Fond du Lac, Wis., gives electricians a 60 day period of grace in which to apply for renewal of their licenses. George L. Rothe, city electrical inspector and secretary of the Board of Electrical Examiners, was instrumental in bringing about the amendment by city officials.

TALBOT GETS CHIEF'S POST

D. J. Talbot, assistant chief electrical inspector of the City of Chicago, was rewarded for his faithful and meritorious service by being appointed chief electrical inspector on Jan. 1, 1944. Dave, as he is known to his host of friends, was acting chief inspector of the electrical department for the past five years. The

SYNTRON
DEPENDABLE
ELECTRIC HAMMERS



Only One Working Part—THE PISTON

Can SAVE You—

$4.00 every hour they're used —that amounts to $160.00 per week

DRILLING CONCRETE
POINTING MASONRY
VIBRATING FORMS
SCALING METAL
CUTTING & CHIPPING
REDRESSING

Four "Heavy-Duty" Models

"MK"—	5/8"	cap. at	$105.00
#16—	1 1/8"	" "	$150.00
#22—	1 1/2"	" "	$195.00
#25—	2"	" "	$225.00

SYNTRON CO.
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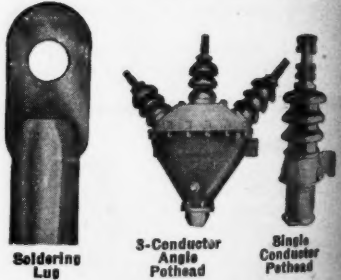
ELECTRICAL SPECIALTIES
FOR HEAVY INDUSTRIAL SERVICE
RMC
FROM STOCK



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ENDULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

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RUSGREEN MFG. CO.
14260 Birwood Avenue • Detroit, Mich.

WING DUCTS made by FRINK help give them speed!

One American-built fighter plane has proved especially effective against the Nazis in Russia. It is deadly efficient at surprising and strafing enemy troops from house-top heights. "Shaving," our Russian allies call it. They call the plane "Little Shaver."

"Little Shaver" owes much of its effectiveness to its speed. Its speed depends in part on its cooling system. And that's where Frink comes in. Frink makes the aluminum ducts that rush cold air from the leading edge of the wings back to the engine. Without this cooling draft of air the engine would quickly over-heat and stall.

The Frink Corporation has specialized in precision manufacturing and engineering for 86 years. During that time the name Frink has become synonymous with quality and skill in the lighting industry.

A pioneer in Fluorescent illumination as well as Incandescent lighting, The Frink Corporation developed LINOLITE, the famous "engineered for vision" Fluorescent equipment now giving such efficient and profitable service in many of America's foremost factories, stores and banks.

Today Frink is heavily engaged in producing war equipment. Tomorrow Frink will resume engineering and manufacturing the high-quality lighting equipment that has gained such an enviable reputation in the industry.

LIGHTING SINCE 1857

Subsidiaries: Sterling Bronze Company, Inc.
Barkon-Frink Tube Lighting Corporation

★ ★ ★ ***All** Frink employees **invest** at least **10%** of their earnings in **War Bonds.*** ★ ★ ★

WE ARE PROUD OF THAT RECORD. LET'S ALL BUY WAR BONDS!

Check Advantages of BELL *Industrial* VOICE PAGING EQUIPMENT

- ✓ Permits plant-wide vocal paging *plus* broadcasting of musical recordings, announcements, time and warning signals, etc.
- ✓ Designed especially for heavy-duty, industrial use.
- ✓ Standard units combine to fill needs of any variety or extent.
- ✓ Compact, tamperproof amplifier units for easy wall or shelf mounting.
- ✓ Quick, easy, low cost expansion or rearrangement whenever desired.
- ✓ Features oil-filled condensers having almost no wear-out factor.
- ✓ Driver and amplifier units can be remotely located; only microphone and on-off switch needed at operator's station.

Because we're busy day and night on war work, your priority may not permit a BELL installation now. But you ll very likely wish to consider it in your plans for post-war efficiency. Write for complete information today.

BELL SOUND SYSTEMS, INC.
1196 ESSEX AVE., COLUMBUS, OHIO
Export Office: 4900 Euclid Ave., Cleveland 3, Ohio

Fuse Clips ALSO 110V *CARRY THE LOAD!*

Your satisfaction in knowing the greatest efficiency is achieved on any circuit job includes *quality fuse clips.*

LITTELFUSE

Silver-Plated, Beryllium Copper

FUSE CLIPS

Silver-plated at no extra cost. Highest electrical and thermal conductivity. Lowest resistivity. Contact resistance lowered about 20 percent. This *in addition* to Littelfuse anti-vibration strength, fatigue resistance and spring qualities equal to steel.

Send for technical bulletin on Fuse Clips and Terminals. Full engineering data. Write

LITTELFUSE INC.
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PROMPT DELIVERY ON ORDERS

RATED AA-5 OR HIGHER ON ALL BADGER OR MODEL W SYNCHRONOUS ELECTRIC TIME SWITCHES

CONTRACTORS LIKE THEM BECAUSE:
they are dependable and easy to install

USERS LIKE THEM BECAUSE:
of economical operation and low cost

The Reliance line of Time Switches is always in demand by Contractors who want dependability, accuracy, and the right type for a specific need. They know from experience that this is the line that gives them successful, profitable installations. They know when they install Reliance Synchronous Electric Time Switches for their customers they are giving them complete satisfaction — accurate timing, economical operation, dependable service. You can't go wrong on Reliance. Write for more particulars or see your Wholesaler.

RELIANCE AUTOMATIC LIGHTING COMPANY
1937 MEAD STREET RACINE, WISCONSIN

position of chief inspector had never been filled since the death of C. K. Cregier in 1939. To date no assistant chief inspector has been named to fill the position left vacant by Mr. Talbot's promotion.

MINNESOTA OUTLAWS SHALLOW BOXES

The Minnesota Electrical Inspectors Association, by a recent decision, banned the general use of the ½-inch shallow type outlet box because of the crowding of conductors. The inspectors permit the use of the ¾-inch shallow outlet box only where one cable or a pair of cables enter and "dead end" at that outlet. Porcelain lampholder receptacles used on such ¾-inch boxes must have a ¼-inch recess to provide space to eliminate crowding or danger of damaging conductors.

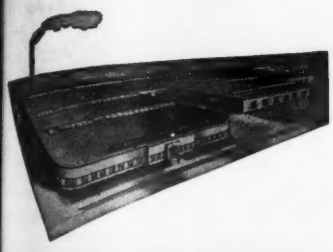
TWIN CITIES CONTRACTORS SELECT '44 OFFICERS

At the annual meeting of Minnesota's Twin Cities electrical contractor groups officers were elected to guide the destiny of the association through the coming year.

Minneapolis Association — Oscar H. Batzli was elected president; F. M. Tripp, vice-president; and W. Arthur Starbird, secretary-treasurer. Those chosen as directors were: A. W. Strohmeier, C. S. Williams, L. E. LeMay, and Al Larson.

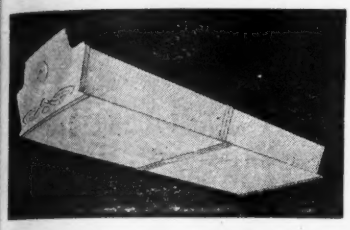
C. A. HOELLE, foreman of the electric motor repair shop, Hagerstown Equipment Co., Hagerstown, Md. Hoelle is always working on some idea or other that will do the job easier and faster and better. One of his most recent accomplishments is a coil winder built from an old 18 inch engine lathe belted to an auto transmission belted in turn to a wound rotor motor giving an infinite speed range.

SPERO ....5 LINES of PRODUCTS from one dependable source



If you are looking for a supplier who will back you up with prompt deliveries on five complete lines of quality products, *priced right*, consider Spero. No need to waste time and lose orders by "shopping around". Speed your estimates and assure yourself of dependable electrical equipment by quoting from this one reliable source.

FLUORESCENT FIXTURES



Commercial and industrial type units—a full line of styles and sizes. Today we feature the new "Spero U.R.C." fluorescent fixture—built to conform to W.P.B. limitations, with diffusing glass panels, engineered for maximum intensity with minimum surface brightness . . . Spero "Instalite," providing instantaneous lighting and eliminating starting switch, is available on most models. Write for descriptive literature.

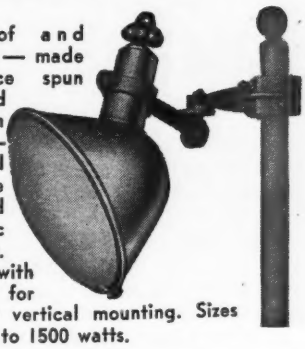
REFLECTORS

A complete line of sizes and types for incandescent lighting—comprising shallow, medium or standard dome type. Keyless or with pull chain. Models with Glass-Steel diffusers also angle or deep bowl types are available. Made for lamp sizes from 75 to 750 watts.

OUTDOOR LIGHTS

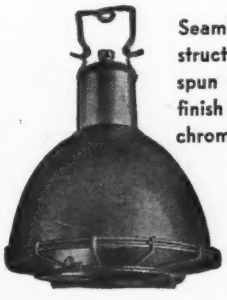
Consists of wall flange, gooseneck, porcelain socket and reflector. These outdoor lights are weatherproof and rust proof. May be applied in any outdoor location requiring a lighting fixture supported from wall or pole. Sizes for 660 to 200 watt lamps.

FLOODLIGHTS



Weather-proof and open types — made of one-piece spun steel, and finished in "Duralum" — Enclosed types are equipped with prismatic glass lens. Furnished with cast bracket for horizontal or vertical mounting. Sizes for lamps up to 1500 watts.

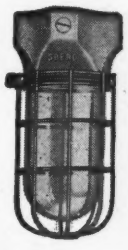
CARGO LIGHTS



Seamless one-piece construction of heavy gauge spun steel with "Duralum" finish over primer of zinc chromate. Center section hinged for servicing lamps. Built to stand rough usage. Available in two styles, single and cluster.

VAPOR-PROOF UNITS

For use around oil wells, gas wells, oil refineries, cleaning establishments, chemical works, paint factories, packing houses, coal mines, meat markets, coolers, grease pits, or on ships, docks, or bases—wherever light is exposed to severe weather conditions, inflammable or corrosive gases.



Finished in "Duralum" with zinc chromate prime. Sizes for lamps of 50 to 500 watts. Furnished for pendant installation or with 90°. Heavy wire guards are optional on all models.

SURFACE CABINETS

Sheet steel door and trim type boxes—with underwriters approval, 49 standard sizes from 4½" x 5" to 60" x 96". Concentric K.O.'s as required.

WIRE HOLDERS

Lag screw or machine screw type, made of highly vitrified porcelain. Metal cup at base prevents breakage. Multiple-point house brackets are also available with and without insulators.

SWITCHPLATES

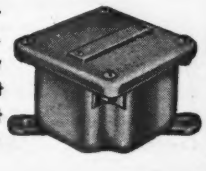
Unbreakable Metaltex switch plates with durable, baked-on wrinkle finish that lasts indefinitely. Brown or Ivory—in more than 20 different sizes and combinations.

DIE-CAST SOCKETS

Diecast of Zamac Zinc, coated with rustproof Duralum; weatherproof — will not corrode. Fits any stnd. 2¼" neck; tapped for ½" conduit; approved porcelain socket. For vertical or horizontal mounting.

NAVY 9-S FITTINGS

9-S Watertight steel enclosures and devises built according to Navy specifications—and approved by the U. S. Bureau of Ships, categories A, B, C, D and E. Immediate delivery from stock on most items, others prompt delivery from current production.



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THE SPERO ELECTRIC CORPORATION

18222 LANKEN AVE. ★ CLEVELAND, OHIO

When You Buy a
BENDER
. . . Check to Make Sure You Get *These* Features

EASY TO GET TO THE JOB
Lightweight and portable, one man can easily carry or roll any Blackhawk Pipe Bender right to the job. Saves time and manpower. Bend rigid conduit and pipe up to 4".

WORK AT ALL ANGLES
Compact hydraulic Porto-Power ram of Blackhawk Pipe Bender works in all directions. Unique design. Avoids kinking. Power eliminates need for heating.

WORK OVERHEAD
All-directional operation and light weight permits work on existing pipe runs.

SIGHT FROM ANY ANGLE
Remote control permits operator to stand in any position necessary to give him full view of job. Blackhawk Benders save need for elbows and couplings and otherwise necessary cutting and threading.

DETACHABLE POWER UNIT *for Extra Utility*
This unit (the heart of the bender) with special available Porto-Power attachments, can be adapted for pulling drive pulleys, lifting heavy equipment into place and doing scores of other trouble jobs.

The Famous Porto-Power Unit

BLACKHAWK MFG. COMPANY
Dept. P2034, Milwaukee, Wis.
Send full information on your pipe benders.
Name.....
Company.....
Address.....
City..... State.....

BLACKHAWK
Porto-Power
PIPE BENDERS

Representatives to the Minnesota Electrical Council Board of Directors are O. H. Batzli, F. M. Tripp and A. L. Glatty.

St. Paul Association—The members decided the present officialdom should carry on for another year and re-elected Don F. Kehne president; Wilbur Hoffman, vice-president; and A. E. Hansen, secretary-treasurer. Directors are Mike Paul, Rudy Gombold and Joseph Fischler. W. F. Lindberg, Paul Schoor, Sr., and D. F. Kehne represent the association on the Board of Directors of the Minnesota Electrical Council.

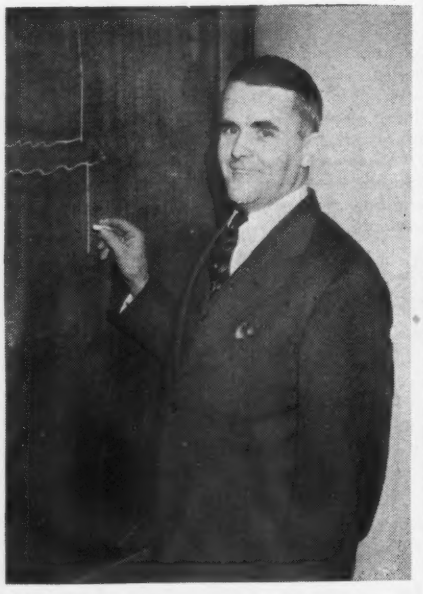
L-161 AND L-277 AMENDED

Distributors' purchase orders for electrical wiring devices and electric fuses that bear preference ratings assigned on WPB Form-547 (formerly PD-1X) must be filled after February 12, by manufacturers as though they were rated AA-2X, the War Production Board has announced.

Such purchase orders, regardless of their actual ratings, are to be treated in in manufacturers' delivery schedules as though they had been assigned AA-2X ratings when originally placed. However, they may not be scheduled for delivery ahead of other purchase orders with AA-2X or better ratings placed before December 30, 1943.

This action is taken by Direction 1 to L-161 (electric fuses) and to L-277 (electrical wiring devices).

A change was recently made in the level of ratings granted to distributors of



BLACKBOARD SESSION by C. C. Taylor, electrical divisional superintendent, Allison Division, General Motors Corporation, Indianapolis, and one of the experts at the electrical maintenance panel of the recent Indianapolis War Production Clinic, gives the audience a clear solution to one of the many problems presented.

K&H Solderless Terminal LUGS — A SIZE and TYPE for every need! — **K&H Solderless CONNECTORS**

SWIVEL U-BOLT CONNECTORS
No Removable Parts
CLAMP and LOCK your CONNECTIONS
This U-Bolt Connector is designed to do just that.
Cat. Nos. 22 to 40. Primarily tap connectors, but also successful as splice connectors by using two connectors where the strain is very heavy. Sizes up to 2,000,000CM.

SWIVEL CLAMP CONNECTORS
No Removable Parts

Open Closed

Cat. Nos. C6 to C10—Screw is withdrawn to certain point where bottom portion of connector will swivel around so that top portion may be hooked over main wire; swung back into position they are ready for clamping. Maximum wire sizes: C6 two No. 4—C8 two No. 1—C10 two No. 2/0.

***Write for* BULLETIN 10-A and 19-A**

KRUEGER & HUDEPOHL
232-8 VINE ST. ★ CINCINNATI 2, OHIO

Safe-T-Glow
HIGH TENSION DETECTOR

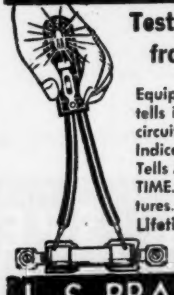
Cut-Out Shows Inside View

SAFETY RULES call for that EXTRA precaution and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

Model A 3-ft. handle
Model B 6-ft. added extension

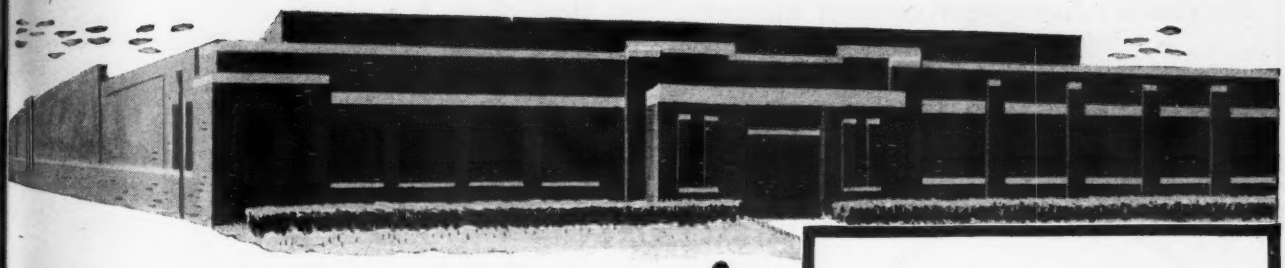
TEST-O-LITE
Tests Everything Electrical from 100 to 550 Volts



Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List $1.50 (Priority A-7) Purchase thru regular electrical dealers.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.

. . . BEHIND THESE WALLS



THINGS ARE *humming*

Essential War Materials? Of Course!

Raco • All-Steel is backing the attack! In this up-to-date factory, skilled and experienced workmen are working long and hard hours on essential war materials.

Boxes, Fittings? These Are Essential War Materials, Too!

This is an industrial war. Raco boxes and fittings play an important part in the construction and operation of war equipment. And industry that turns out these mighty weapons of destruction depends on electricity, too—on electrical parts to light the work, distribute power and maintain communication lines. Raco • All-Steel's first job is to back up the war effort in every way possible.

What's New? This Subject Is Not Being Neglected!

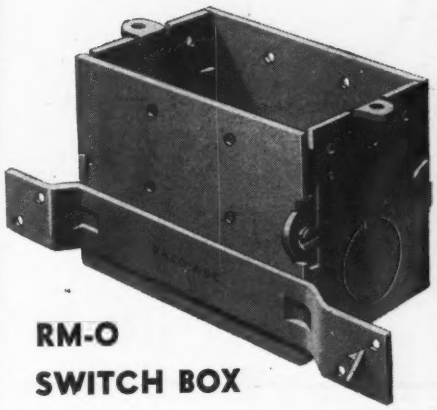
War business, of course, takes precedent at Raco • All-Steel but we are not forgetting about "tomorrow." Postwar plans are already in the making. Engineers are keeping in step with all developments in construction materials, wiring materials and wiring trends. In the postwar electrical world, you will be able to meet the huge demands—by standardizing on the complete line of products identified by the nationally accepted Raco Flag and A-S-E Emblem.

Distributed by

ALL-STEEL EQUIP COMPANY, INC.

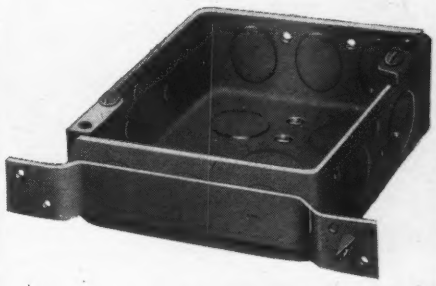
603 Griffith Avenue, Aurora, Illinois

There is a complete line of RACO • ALL-STEEL products



RM-O
SWITCH BOX

Especially designed for use in residential work with modern wall materials of any thickness.



CO-1/2-O
SQUARE OUTLET BOX

Preferred for industrial and other heavy construction jobs.

RACO • ALL-STEEL • PRODUCTS

SWITCH BOXES • OUTLET BOXES • CONDUIT FITTINGS

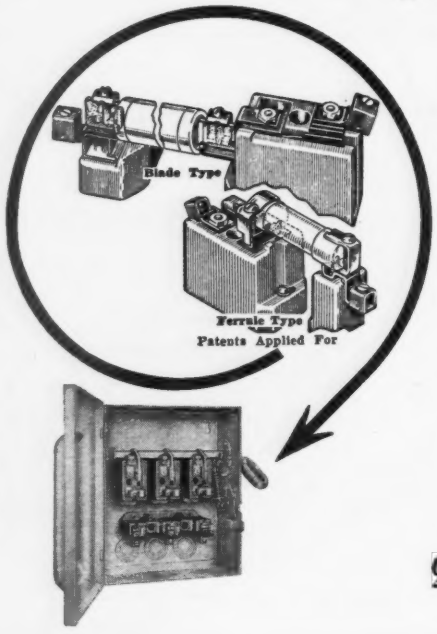
FUSES TOO HOT?

Maybe it's from poor contact between fuse and clips

STOP IT

USE WADSWORTH Safety Switches with

FUZE-TALONS



FUZE-TALONS: The Wadsworth new development illustrated are designed on the "High Pressure Line Contact" principle. They Hold Tight and conquer vibration.

Standard on Wadsworth Type "A" and Type "C" Safety Switches 60 amperes and up.

Sold through Leading Electrical Wholesalers.

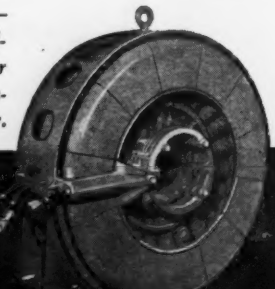
The WADSWORTH ELECTRIC MFG. CO. INC.
Covington, Kentucky.

BURKE *Induction* MOTORS

Investigate Burke's line of Induction Motors for application from 1 to 1500 H.P. All welded frames, no rivets or bolts—air gap held to very close limits—all coils are form wound and treated with plastic, age-resisting composition, vacuum impregnated. Individual coils easily replaced — a modern sturdy design.

Burke Motors available in all forms and types. Multi-speed — drip and splash proof — enclosed fan cooled—vertical-flange—round frame—elevator —crane and hoist, etc. for continuous and short time duty.

WRITE FOR BULLETIN 101-A



BURKE ELECTRIC CO.
ERIE PA., U.S.A.
AC & DC GENERATORS
AC & DC MOTORS
EXCITERS
TERMINAL BLOCKS
MOTOR GENERATOR SETS

fuses and wiring devices covered by the orders. These directions are designed to re-rate purchase orders that had been assigned ratings before this change. Without such automatic re-rating, a great deal of paperwork would have been required in reprocessing the old purchase orders individually.

PRIORITIES REGULATIONS NO. 11 AND 11A REVOKED

Inasmuch as the Production Requirements Plan, which distributed materials to war and essential civilian production on a plant rather than a program basis, was superseded on July 1, 1943, by the Controlled Materials Plan which does make materials available on a program basis, WPB Priorities Regulations No. 11 and 11A, which implemented PRP have become invalid.

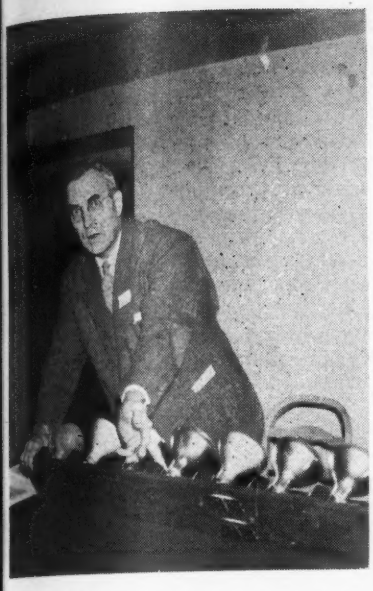
These two Regulations have now been revoked, the WPB has announced finally liquidating PRP, except for possible continuing liability under it. The revocation orders do not terminate such liability.

INTERPRETATION NO. 10 ISSUED TO CMP REGULATION NO. 1

Rules governing changes in authorized controlled material orders have been clarified through the issuance of Interpretation No. 10 to CMP Regulation No. 1 by the War Production Board.

The interpretation chiefly concerns determination of when a change in an authorized controlled material order constitutes placement of a new order and

***BROTHERS** in electrical maintenance fields—C. J. Weissler (left) is chief electrician at the McQuay-Norris Ordnance Plant, St. Louis and J. Weissler follows the same footsteps as electrical foreman at the National Foundry Co., also at St. Louis, Mo.*



HEAT LAMPS and their various farm applications were demonstrated by L. C. Porter, General Electric Co., at the recent Chicago conference of the American Society of Agricultural Engineers.

when it does not. It is important for producers to know when a change constitutes a new order so that they may be in a position to adjust their production schedules of controlled materials accordingly.

Generally, any change in a customer's order constitutes a cancellation of the earlier order and placement of a new order on the date of the change, if (but only if) the change necessitates alteration of the producer's production schedule to a point which would interfere with production.

In illustration of this general rule, the Interpretation points out seven specific cases, as follows:

(1) The mere substitution of one allotment number for another which does not require alteration of the producer's schedule is not considered to constitute the placing of a new order. The customer must, of course, have an allotment identified by the substituted allotment number to support the change.

(2) A change in shipping destination does not constitute the placing of a new order.

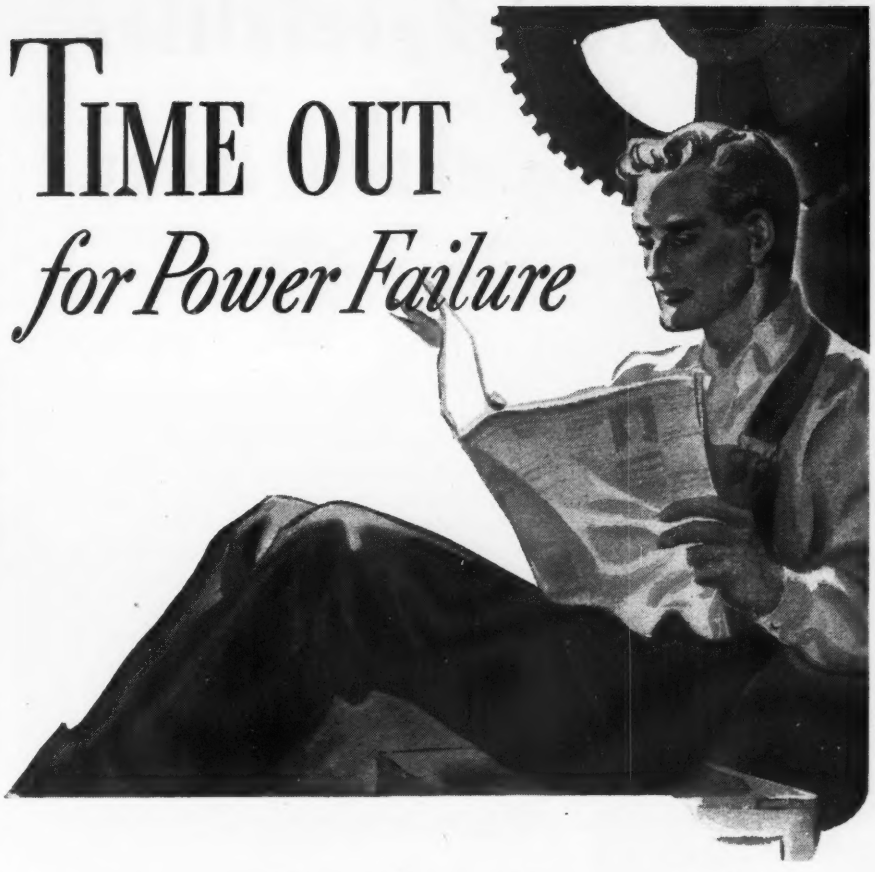
(3) An increase in the total amount ordered constitutes the placing of a new order to the extent of the increase.

(4) An advancement or deferment of delivery, when made by the customer, will constitute entry of a new order.

(5) A reduction in the total amount ordered will presumably not require a change in the producer's schedule and will not constitute a new order. Of course, if the quantity is reduced below a minimum mill quantity, the producer may reject the order and remove it from his schedule, as provided in paragraph (t) (2) (i) of CMP Regulation No. 1, though he must not discriminate between customers in so doing.

(6) When the customer directs the producer to hold or suspend production on an order, without specifying a new delivery date, the order will not be considered as on a producer's books for the purpose of determining his obligation to accept

TIME OUT *for Power Failure*



Insure Production with DELTABESTON

Have you checked the hot spots in your wiring system where high temperatures ruin ordinary electrical cables? Unexpected failures of power and lighting circuits can make your plant lose production, profits and precious time. Why trust your war jobs with cables that *might* fail. Rewire your next job with Deltabeston Asbestos-insulated Wire or Cable. Then dispel all fear of unexpected power failures and production "time-outs."

Deltabeston is constructed to fortify electrical circuits with extra protection in installations where excessive heat, humidity and corrosive vapors prevail. It protects well where electrical trouble usually breaks out.

Here are only a few of the many Deltabeston Wires and Cables with the heat-resistant insulations:

DELTABESTON POWER CABLES Types AVA or AVL for general wiring in power plants, steel mills, boiler rooms and in other torrid zones where constant high temperatures are a problem.

DELTABESTON SWITCHBOARD AND HINGE CABLE Types AVB or SNA for wiring swinging panel connections, general switchboard and all other types of control apparatus.

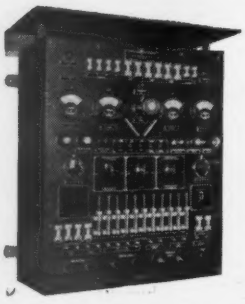
DELTABESTON BOILER ROOM WIRE Type AVA for wiring in central stations, steel mills, boiler rooms and other installations where resistance to high ambient temperature is required.

For additional information write to Section Y343-8, Appliance & Merchandise Department, General Electric Co., Bridgeport, Conn. Deltabeston Wires and Cables are distributed nationally by Graybar Electric Co., G-E Supply Corp. and other G-E Merchandise Distributors.

BUY WAR BONDS ★

GENERAL ELECTRIC

Electrical Specialties
of Every Type
Including MARINE WORK



WORK TEST PANEL—built to customers' specifications and Navy standards.

RADIO MOTOR-GENERATOR and SELECTOR CONTROL PANEL—built to customers' specifications for any number of circuits.

JMM CO

ALL types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army, Navy and Commercial specifications. Full engineering personnel and equipment for manufacture of special electrical items to customers' needs in addition to all standard articles. Let us quote you on your requirements. Write for illustrated catalog.

Jacksonville Metal Manufacturing Company
247 Riverside Avenue
Jacksonville, Florida

TAL'S *Prestal*
HYDRAULIC PORTABLE

PATENTS and PATENTS PEND.

PIPE BENDER

for steel pipe and conduit from ⅜" to 4½"

- NO HEATING
- NO FILLING
- NO KINKS
- NO WRINKLES

Make your offsets and bends up to 90° (and more) in one single, simple operation in a few minutes.

The pipe is NOT MOVED during the bending thus avoiding kinks and wrinkles. All bends—one or 1000 all identical and perfectly uniform even if made by "green hands."

Quick changeover to various sizes. Few seconds to mount and dismount. FASTEST PORTABLE BENDER!

SMOOTHNESS OF BENDS:

No wrinkles—no kinks—no breaking of pipe due to scientific development of bending formers. No job too complicated.

Meets U. S. Navy, Army & Maritime Comm. Specifications
Write today for circular giving complete description
New Jobbers and Representatives Considered

TAL'S PRESTAL BENDER, INC.
Dept. E-3 Milwaukee, Wisconsin

HYDRAULIC PORTABLE TAL'S PRESTAL

other orders. When the customer instructs the producer to reinstate a suspended order, it shall be considered a new order as of the date of such instruction.

(7) Where minor variations in size, shape, gauge, etc., are requested by the customer and can be arranged by the produced without interfering with his production, such changes do not constitute a new order.

Where changes constitute placement of new orders, the acceptance or rejection of the new order and its place in the producer's schedule shall be governed by conditions existing at the time the changes are received by the producer.

These rules, which are set out in Interpretation No. 10 to CMP Regulation No. 1, as amended January 10, 1944, supersede Interpretation No. 12 of CMP Regulation No. 1 and CMPL letter 414, which are revoked.

ELECTRIC SIGN MANUFACTURERS ORGANIZE

Following three months of preliminary work, the National Electric Sign Association was formally organized on January 11, 1944. At a meeting in Chicago's Palmer House, a group of 39 charter members including electric sign manufacturers and their suppliers adopted a constitution and elected officers and directors. Headquarters have been established at 224 South Michigan Ave., Chicago.

A well rounded program, developed to cope with present and postwar problems, includes the following activities:

1. To protect, defend and advance both national and local commercial and legal rights and privileges of the Electric Sign Industry and to cooperate with legislative committees, governmental agen-

TWELVE YEARS in naval service is the record of Chief Electricians Mate, Orlay R. Larrabee, U. S. Coast Guard, St. Louis, Mo. His present duties place him in charge of all Coast Guard electrical construction and maintenance in the St. Louis District and Coast Guardsmen seeking electricians ratings must get his approval as a member of the Board of Examiners.

FARM WIRING requires materials that will withstand the moisture and acid conditions in farm buildings, C. P. Wagner, district engineer, Northern States Power Co., told delegates to a recent conference of the American Society of Agricultural Engineers in Chicago.

cies and departments in regard to matters affecting the industry.

2. To inaugurate progressive self-educational programs and policies designed to develop new opportunities for the sale, manufacture and maintenance of electric signs and to extend such programs for the mutual benefit of the customer, the industry and the public at large.

3. To work toward a more efficient and practical standardization of materials and production methods to increase quality and efficiency of electric signs made and maintained by the members.

4. To conduct continuous research in new materials and production methods.

5. To establish and maintain a high standard of employer-employee relations.

6. To achieve uniformly efficient and equitable maintenance and manufacturing services.

7. To establish cordial and cooperative relationships with other related organizations.

8. To record, for reference, all available local sign ordinances and to work progressively toward improvement and standardization of such ordinances.

9. To accept the responsibilities of sound and ethical business practices implied in the aims of the Association and to apply these practices in the conduct of business of each individual member.

The following officers were elected for the first year: president, John Aull, Swanson-Nunn Electric Co., Evansville, Ind.; vice-president, Harry Parker, Flashtric Sign Works, Chicago; secretary-treasurer, George C. Kirn, Jr., G. C. Kirn Adv. Sign Co., St. Louis, Mo.

Maurice R. Ely was elected as Executive Secretary to direct the activities of the Association. Mr. Ely spent 17 years with the Electric Association in Chicago and was secretary-treasurer of the Chicago Electrical Maintenance Engineers and also of the West Suburban Electric League.

GREENLEE BENDER

"simple to operate ... easiest to shift from job to job"

TIME-SAVING TOOLS FOR ELECTRICAL WORK

BENDERS. Complete line of powerful hydraulic and hand benders for every bending job: pipe up to 4½"; rigid and thin-wall conduit; steel, brass and copper tubing; bus-bars.

CABLE PULLERS. Makes the tough job of cable pulling easy. Pulls cable into exposed or concealed conduit in half the time required with cumbersome equipment. Easily carried, operated by one man.

JOIST BORERS. The convenient, work-saving way to bore holes in joists for knob-and-tube wiring and for conduit. Ball bearing operation. Easily assembled.

KNOCKOUT TOOLS. Greenlee Knockout Punches and Knockout Cutters save hours of work in cutting smooth accurate holes. Enlarge holes without drilling, reaming or filing.

RADIO CHASSIS PUNCHES. A special Greenlee tool for cutting holes in radio chassis for sockets, plugs and other receptacles. Cuts or enlarges holes in a jiffy. A big time saver for the radio worker.

PIPE PUSHERS. One man easily pushes pipe through ground by powerful hydraulic action. Eliminates extensive trenching, tearing up lawns and pavement in installing pipe.

That's what A. W. Rose of Oscar M. George Company, Chicago, reports about their Greenlee Hydraulic Bender, shown above, which they've been using the past six years. And simple *one-man* operation plus easy portability is mighty important when manpower is short.

About saving time and cutting costs Mr. Rose says their Greenlee "saves 75% on man-hours and cuts material spoilage 10%."

It's easy to see how a Greenlee Bender pays for itself the first few times used!

You get smooth, perfect bends quicker, without kinks and without scratching the conduit finish. Many elbows and fittings are eliminated.

Whatever your bending job ... pipe up to 4½", rigid and thin-wall conduit, tubing or bus bars ... there's a Greenlee Bender to do it better and faster. Get the facts now. Write for Catalog 33E, on Greenlee Benders and other special tools for electrical work. Greenlee Tool Co., 1743 Columbia Avenue, Rockford, Illinois.

Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

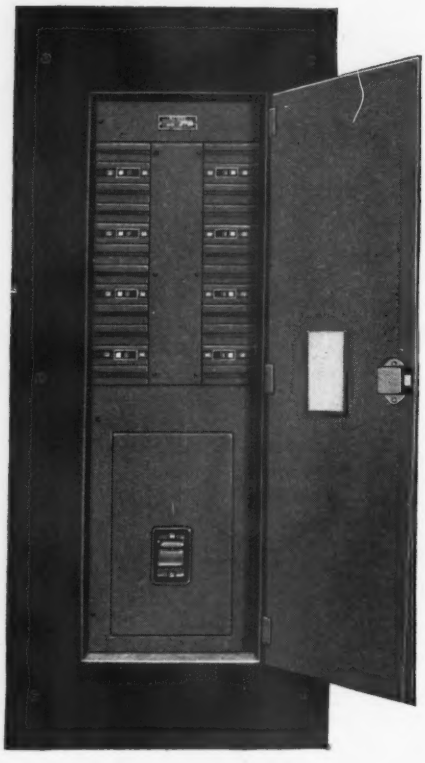
HOW TO PREVENT POWER FAILURES

THIS SAFER PROTECTION FOR POWER CIRCUITS KEEPS YOUR PRODUCTION UP TO SCHEDULE

Now you can get rid of power-failure worries for good and make sure of keeping every machine and operation in your plant running on schedule by specifying Kinney "Nofuze" Circuit Breaker Panels for your power distribution system.

These panels give greater freedom from work stoppages because their patented "Nofuze" circuit breakers are not affected by momentary overloads that constantly occur when machines are operated at peak capacity in 24-hour-a-day war production. In fact, the inverse-time characteristic of the breakers in Kinney "Nofuze" Power Panels actually resist tripping on harmless overloads, yet trip faster and more positively on dead shorts or overloads which are dangerously prolonged.

Here is unfailing *double protection* for your plant's vital power distribution system. You are protected *first* against annoying production delays resulting from minor overloads, and you are protected *secondly* against costly shutdowns resulting from major damage to your system from shorts or serious overloads.

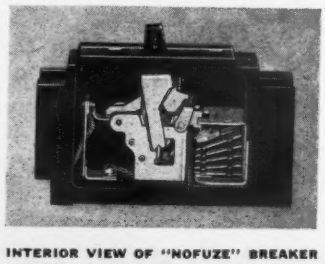


Kinney "Nofuze" Power Panels Give You These Superiorities

- **Thermal-element breakers have inverse-time characteristic**
- **Breakers feature deionizing principle arc quench**
- **Full time delay on harmless overloads**
- **Quick tripping on dead shorts**
- **Listed by Underwriters' Laboratories**

Act now to assure your plant of this double protection with Kinney "Nofuze" Powel Panels, available in both Narrow Distribution and Convertible Distribution types.

The Kinney line also includes "Nofuze", "Uni-Breaker" and "Quicklag" circuit breaker lighting panels; Switch-and-Fuse Panels and Switchboards.



INTERIOR VIEW OF "NOFUZE" BREAKER

PANELBOARDS **KINNEY** SWITCHBOARDS

KINNEY ELECTRICAL MFG. COMPANY • 2900 CARROLL AVENUE • CHICAGO 12, ILLINOIS

NEW COPPER ORDER ISSUED

To streamline the regulations governing copper raw materials, a new order has been issued by the War Production Board. The new copper order, M-9, supersedes two orders that were revoked, M-9-a, Copper Base and Copper Base Alloys and M-9-b, Copper Scrap and Copper Base Alloy Scrap.

In addition, WPB issued Direction 1 to the new copper order for the purpose of maintaining a steady flow of needed grades of copper scrap and preventing the accumulation of needed copper scrap in the hands of scrap dealers.

The inventory restriction of the new order has been changed to provide that no person (other than a scrap dealer or one who is in the business of producing copper raw materials or copper controlled materials) shall keep on hand more than 3 days' accumulation of scrap unless such accumulation aggregates less than five tons.

CMP REGULATION NO. 4 MODIFIED

Rules governing sale of copper, steel, and aluminum in controlled materials forms and shapes by warehouses and distributors have been changed to ease applicable restrictions on such transactions, WPB has announced.

Revised provisions of CMP Regulation No. 4, relative to warehouse sales of copper wire mill products permit purchasers to place orders with warehouses for not more than 3,000 pounds of such products for delivery from stock of any one item to one destination during any one calendar month.

However, this limitation does not apply to resale of copper wire mill or brass mill products which have been obtained by warehouses through authorization from the Copper Recovery Inventory Branch or from a WPB Regional Office. Neither does the limitation apply to condenser tubes, in the case of brass mill products.

The change will permit warehouses to sell copper wire mill or brass mill products which were idle, or excess stocks of the products, to fill authorized controlled material orders without quantity limitation.

The amended regulation permits a warehouse to reject orders for immediate delivery of copper wire mill or brass mill products which it does not have in stock, or knows to be in transit to its stock. In addition, they may reject orders calling for future delivery. However, if they elect to accept such orders, they must not set aside or hold materials to fill them.

General provisions of the regulation are amended to require that any authorized controlled materials order for steel, copper wire mill or brass mill products, or aluminum shall be considered to require immediate delivery unless the purchase order specifically states otherwise.

Brevity is the Soul of Wit—

WHEN IT COMES TO

Conserving Paper

SURE IT'S EASIER to let your dictation roll along. Sure it's easier to write long copy. Sure it's easier to do all the good, pleasant things of normal peacetime business when paper is like water, something you can pretty well use as you will.

But now, when the increasing paper needs of the armed services daily decrease the national supply of paper—when paper is a true war essential—that's a different story.

All of us in business must watch every piece of paper or paper board we use. We must judge its use in terms of absolute necessity. We must not use a single piece, a single inch, of paper which thriftier writing or printing or packaging can possibly save.

For multiplied on a national scale, that particular piece or inch of paper or paper board becomes the tonnage needed by our service forces to ship precious food and ammunition and weapons and medical supplies and blood plasma to our troops overseas.

If there's no Paper Conservation Committee in your organization or in your community, why not get one going today?

This advertisement prepared under the auspices of the War Advertising Council in co-operation with the Office of War Information and the War Production Board.

USE LESS PAPER BECAUSE

It takes 25 tons of blueprint paper to make a battleship.

700,000 different kind of items are shipped to the Army—and they're paper-wrapped or boxed.

"K" ration containers, shipped from the Eastern Seaboard alone, take 662 pounds of paper a month.

Each Signal Corps radio set takes 7 pounds of kraft paper, 3 pounds of book paper.

Each propelling charge for 155-millimeter shell takes 3/5 pound of paper.

USE LESS PAPER THESE WAYS

Review all printed forms periodically for essentiality; consolidation; elimination of waste space; standardization of sizes, weights, color, grade; elimination of color where possible.

Eliminate slack fills, thus effecting the economies of a smaller package.

Use 8½x5½-inch letterheads for short letters; inclose them in small envelopes.

Adjust the number of units per case to the maximum practical.

Use and re-use carbon paper consistently.

Conversely, reduce the number of units to utilize lighter carton board when such reduction will result in less tonnage over-all. Be sure that the openings are on the smallest dimension of the shipping container, so that the flaps will have the smallest area possible.

LET'S ALL USE LESS PAPER

Space for this advertisement contributed by ELECTRICAL CONTRACTING

ELECTRICITY
For Any Job—Anywhere

For a dependable source of electricity on projects remote from commercial power, Onan Electric Plants are proven leaders in the field. More than half of the Armed Forces' total requirements for Power Plants are built by Onan.

Gasoline driven . . . single-unit, compact design . . . Sturdy construction . . . Sound engineering . . . Suitable for mobile, stationary or emergency service.

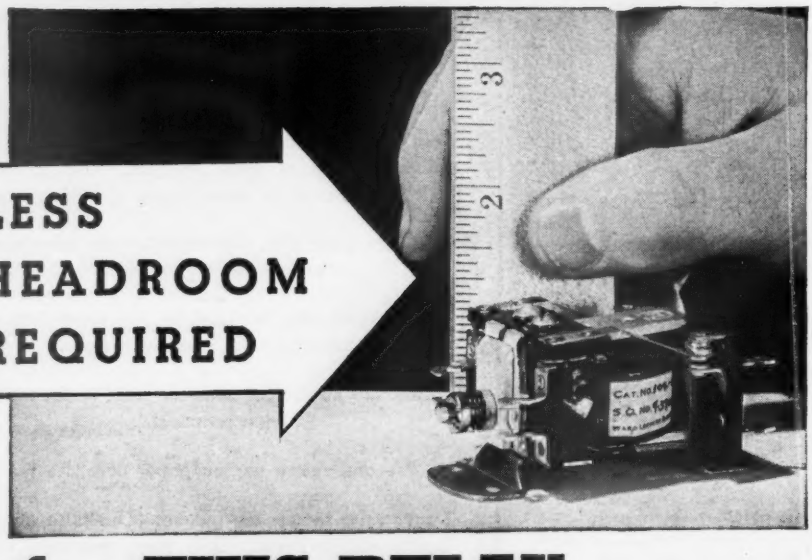
Over 65 models, ranging in sizes from 350 to 35,000 watts. 50 to 800 cycles, 110 to 660 volts, A.C.—6 to 4000 volts, D.C.—Also dual A.C.-D.C. output types.

Descriptive literature sent promptly on request.

D. W. ONAN & SONS
2087 Royalston Ave.
Minneapolis, Minn.

Awarded to each of ONAN's four manufacturing plants.

ONAN
ELECTRIC PLANTS



LESS HEADROOM REQUIRED

for THIS RELAY . . . .

The WARD LEONARD Midget Metal Base Relay measures only 1¼" in height. Its sturdy design permits continuous service on standard AC and DC voltages up to 110-115V. This double pole, double throw relay has the silver-to-silver contacts characteristic common to all Ward Leonard Relays. Data bulletins are available describing various Ward Leonard Relays. The line is complete.

Send for bulletins of interest to you.

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WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC CO., 28 South St., Mt. Vernon, New York

LIMITATION ORDER L-250 AMENDED

The War Production Board has announced it has relieved manufacturers of electric motor controllers from the technicality of obtaining an AA-5, or higher, priority before starting production on these units or parts therefor.

The action was taken in an amendment to Limitation Order L-250 and is designed to permit manufacturers to make economical runs of components for the controllers. Technically, as the order stood before this amendment, manufacturers had to obtain an AA-5, or higher, rating before manufacturing components.

The requirement of obtaining an AA-5, or higher, priority before acceptance or delivery of completed electric motor controllers remains in force.

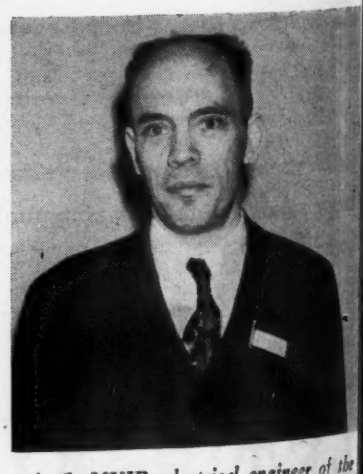
AMENDMENT TO CMP REGULATION NO. 1

Rules governing the use of controlled materials after they are received by a manufacturer have been clarified in an amendment to CMP Regulation No. 1, which deals with basic CMP allotment procedure, it has been announced by the War Production Board's Controlled Materials Plan Division.

The amended Regulation permits a manufacturer to use surplus material to fill another authorized production schedule than the one for which the material was originally acquired, if he changes the original allotment account.

Formerly, a manufacturer could only use such material to fill another authorized production schedule if the other schedule was identified by the same claimant agency letter symbol.

The amended Regulation states that a consumer of controlled materials may keep such materials and Class A products received in a common inventory. In withdrawing from this inventory, he does not have to charge these products or materials against his allotment account.



A. C. MUIR, electrical engineer of the Berwind-White Coal Mining Co. who presented a paper on Lightning Protection of Industrial Equipment at the January Technical meeting of AIEE in New York City.

Manufacturers operating under several production schedules do not have to maintain separate records for each schedule, if their usual records indicate that the production on each schedule is substantially in proportion to the amount of the allotments received for each schedule, and that their aggregate production of any product does not exceed the aggregate of the production schedules authorized.

Consumers of controlled materials must charge their allotment accounts with materials acquired under Priorities Regulation No. 13, unless that Regulation indicates that such a charge is unnecessary. In certain instances, WPB Regional Offices are permitted to allow the allotment purchase of controlled materials, under provisions of priorities Regulation No. 13.

The modified CMP Regulation No. 1 requires that consumers check on their allotments the first of each month, and if they find that they have been allotted more controlled materials than they need, returns of the excess must be made by the tenth of the same month.

At the end of each calendar quarter, a consumer of controlled materials must determine whether he has used his entire allotment by placing authorized controlled material orders or making allotments to secondary consumers, and, if he has any excess, regardless of how small it is, he must return it by the tenth day after the close of the quarter.

Minor changes are made in the symbols designating Claimant Agencies.

In addition, the list designating controlled materials has been spelled out in greater detail, indicating more specifically what materials are in the different categories.

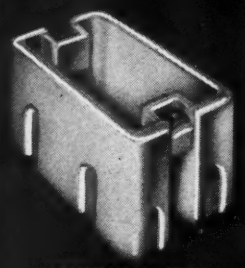
RESTRICTIONS ON USE OF F-12 GAS CONTINUED

Restrictions on the use of F-12 gas (freon), a hydrocarbon used in refrigeration and air-conditioning systems, will now be continued until August 31, 1944, according to the War Production Board.

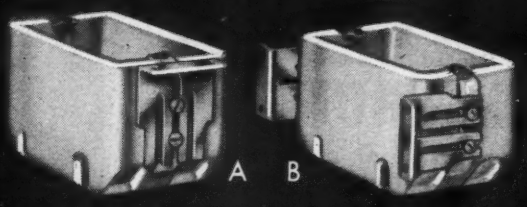
Originally the restrictions on the use of this gas were scheduled to be lifted on March 31, 1944. However, delays in the construction and operation of the new plant of Kinnetic Chemicals Inc., the only producer, at Deep Water, N. J., and an estimated shortage in the supply of anhydrous hydrofluoric acid, which is used in the production of freon, make the extension of restrictions necessary, WPB said.

Exemptions to these restrictions include small systems using less than 10 pounds of freon and utilized to store penicillin, blood plasma and drugs, and certain cold storage systems where a change to other refrigerants, mainly methyl chloride, is not possible because of the particular construction of the system.

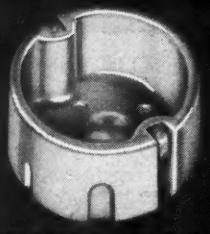
The extension of these restrictions is contained in an amendment to Conservation Order M-28.



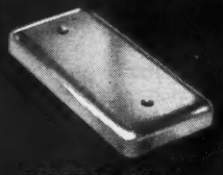
SP18318 Utility Switch Box



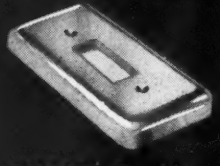
SP18311 Beveled Switch Box with adjustable mounting brackets for end mounting A or side mounting B



SP18313 Round 3 1/2 in. Outlet Box, also similar SP18314 Round 4-in. Outlet Box



SP18328 Blank Switch Box Cover



SP18378 Tumbler Switch Box Cover

SP18333 Round 3 1/2 in. Pendent Cover, also similar SP18334 Round 4-in. Pendent Cover

SP18323 Round 3 1/2 in. Blank Cover, also similar SP18324 Round 4-in. Blank Cover

G·E

PORCELAIN BOXES AND COVERS

FOR DURABLE, ECONOMICAL WIRING

G-E high quality porcelain boxes and covers are ideal for use in wiring farm buildings, war housing, etc. They can be used to advantage in some industrial wiring installations too. They help provide durable, safe and economical wiring systems.

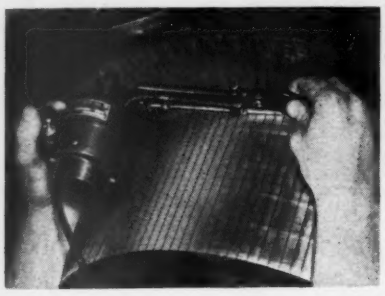
These boxes and covers are made from high grade porcelain by craftsmen with long experience. They are easy to install. The boxes are designed to receive standard wiring devices. The covers will fit accurately.

For further information see the nearest G-E Merchandise Distributor or write to Section C341, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

★ BUY WAR BONDS ★

GENERAL ELECTRIC

HULLHORST UNDERCUTTER



PORTABLE NO. 62

● Here is a light weight—compact—handy—portable mica undercutter ideally suited for industrial maintenance men and motor repair shop crews.

LIGHT WEIGHT—weighs only 4 lbs.

COMPACT — Gets into smaller spaces.

CAPACITY — Undercuts horizontal commutators up to 30" dia.

MOTOR —Light, powerful, ball bearing equipped.

SMALL CUTTER—Allows smooth operation, gets closer to riser—lower cutter cost.

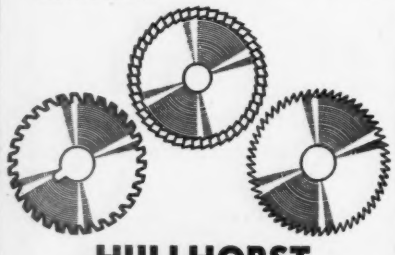
BLOWER—Ample for blowing mica dust away for best visibility.

SIMPLICITY—Fewer parts than most undercutters—no flexible shafts to give trouble.

The price of the No. 62 Undercutter with 110 Volt Universal DC motor or 25 to 75 cycle AC includes carrying case, bar, screw driver and 20 Hullhorst High Speed Steel (¼") Cutters —4 each of .015", .025", .030", .035" thickness or assorted as you want them. Also furnished with 220 Volt Universal motor at slight increase in price.

HULLHORST Mica Undercutter No. 10

A compact, high production, undercutting machine, handling armatures up to 6½" in dia. and shafts up to 17¾" long. Built specifically for manufacturers and large electrical service shops.



HULLHORST High Speed Steel Commutator Saws

An adequate supply of all important standard sizes in carried in stock. Specify Hullhorst for—faster cutting —longer life — adaptability to all types of Mica Undercutters. In ordering give diameter, hole, thickness and purpose for which intended.

HULLHORST MICRO TOOL CO.
Division of
TOLEDO STANDARD COMMUTATOR CO.
2242 SMEAD AVE.
TOLEDO 6, OHIO

VERNON WEAKLEY, maintenance electrician at the Newark, Ohio plant of Owens-Corning Fiberglas Corporation, has received as his third award the largest amount ever paid by the company for an employee's suggestion. Weakley has been awarded $500 for devising a simplified measuring limit switch to control an automatic chopper that cuts an endless blanket of Fiberglas wool into bats of prescribed length.

ELECTRIC FENCE PRODUCTION ACCORDING TO SCHEDULE

The Electric Fence Controller Industry Advisory Committee has reported that manufacture of electric fence controller products is proceeding according to a schedule.

These devices, which permit slight electric impulses to be transmitted through fence wire at determined intervals, aid stockmen to confine cattle to enclosed areas.

The use of single-strand, electrified fence wire, instead of the traditional woven wire fencing or multiple strands of barbed wire, enables cattlemen to conserve considerable quantities of material and labor required for fence building. As a result of increased demand for electric fence controllers, the industry will have in the 12 months ending June 30, 1944, produced a substantially greater quantity of these devices than in any previous year.

REFRIGERATION REPAIR MEN NEEDED

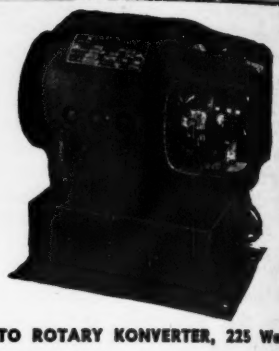
Experienced refrigeration repair men, now working on jobs less important to the national welfare, have been requested by the War Manpower Commission to return to their former occupations. The peacetime total of approximately 28,000 of these repairmen in domestic service has decreased about 70 per cent, or 19,600, during the war, WMC said.

The shortage of such workers, WMC said, presents a serious threat to national health. War conditions make proper refrigeration, always necessary, vitally important. Refrigeration equipment, however, is impossible to replace. Old machinery must be repaired and kept in use if the nation's food supply and the people's health are to be preserved.

110-Volts A. C. from Direct Current

On the Fighting Front On the Home Front

with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.



KATO ROTARY KONVERTER, 225 Watts

Good deliveries on rotary converters 350 through 1500 watts. Quiet in operation. Can be furnished with special filtering equipment for sensitive radio work.

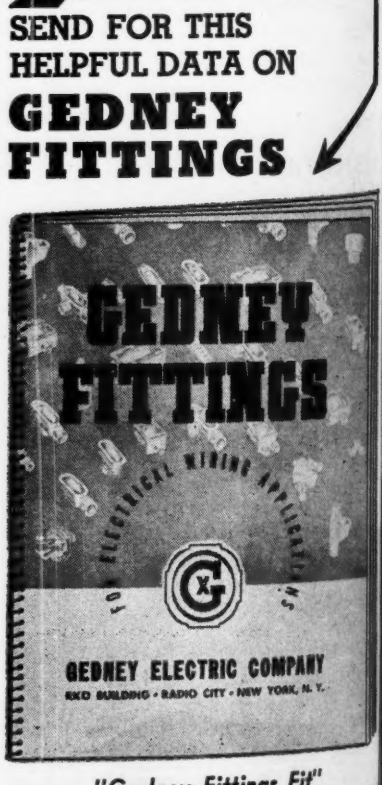
Pioneers in the Building of Small Rotary Converters

At present Kato's entire production must be directed to furnishing converters on high priority orders. Write us if you need this kind of equipment for war orders.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.
628 N. Front St., Mankato, Minnesota

SEND FOR THIS HELPFUL DATA ON
GEDNEY FITTINGS



"Gedney Fittings Fit"
SOLD THROUGH WHOLESALERS
GEDNEY ELECTRIC COMPANY
RKO BUILDING NEW YORK 20, N. Y.

How electricity was harnessed for modern use--

the life-story of ELIHU THOMSON

Not only the inspiring story of Elihu Thomson, pioneer and genius of the electrical age and his great personal contributions to the field of electricity in inventions and developments of electrical machines and appliances. This biography also embraces important, modern electrical developments, telling the story of history-making inventions and giving intimate views of the men who made them: Edison, Westinghouse, Steinmetz, Kelvin, Crooks, Marconi, and a host of others whom Elihu Thomson knew well.

Just Out!

BELOVED SCIENTIST

ELIHU THOMSON

A Guiding Spirit of the Electrical Age

By DAVID O. WOODBURY

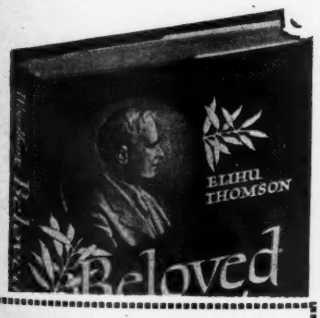
With a foreword by Owen D. Young

358 pages, 6 x 9, 20 illustrations, $3.50

Here, vividly told, are many such absorbing developments in the electrical field as:

- the founding of General Electric
- the harnessing of electricity for lighting, trolleys and all the hundreds of appliances which today we take for granted
- establishing the first industrial laboratory
- discovering startling new methods for the use of the dynamo
- the chance discovery of electric welding
- perfecting arc and incandescent lighting

See it 10 days



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Light-weight . . . made of asbestos and cement, Johns-Manville Transite Ducts are light and easily handled. Thinner walled Transite Korduct, for use in concrete envelopes, is especially light in weight.

Long lengths . . . these ducts are so strong and light that they can be made in longer lengths to save you time, with fewer joints, fewer spacers.

Easily assembled couplings . . . The use of tapered sleeve couplings further speeds up installation and assures permanently tight joints.

No concrete envelope necessary . . . with Transite Conduit. It's so strong, so rotproof, fireproof, and rustproof that—underground or above ground, it needs no protective concrete casing, paint, or other preservative treatment.

Long, trouble-free life . . . Made of two mineral products, Transite Ducts get stronger with the years. Cannot deteriorate.

No priorities needed . . . Being non-metallic, Transite Ducts are readily available in quantity for whatever use you may have for them.

JM PRODUCTS JOHNS-MANVILLE

TRANSITE DUCTS

TRANSITE *CONDUIT* Designed for exposed work and for use underground without a concrete encasement. Saves plenty of installation time.

TRANSITE *KORDUCT* For use in concrete. Thinner walled, otherwise identical with Transite Conduit

Big Beam
PORTABLE ELECTRIC RECHARGEABLE
HAND SEARCHLIGHT

Demonstration proves its true value.

Provides
DAYLIGHT VISIBILITY FOR NIGHT JOBS
and
EMERGENCIES

★ BIG BEAM is in a class all by itself . . . there is nothing remotely like it. The light beam picks out objects over 2,500 feet away—interchangeable lens diffuses the same volume of light over a wider area for close-up work. Hard wear does not impair efficiency and heavy duty battery is shockproof. Battery does not have to be removed from container for recharging, method is simple, clean and safe. Large industrial plants all over the country are BIG BEAM users. Our NEW Catalog gives complete facts on all types of BIG BEAM Portable Electric Rechargeable Hand Searchlights and the Accessories . . . send for a copy today. The time is right to get started on this profitable product.

Big Beam
U-C LITE MFG. CO.
11 EAST HUBBARD STREET
CHICAGO 11, ILLINOIS

MANUFACTURERS NEWS

WESTINGHOUSE CHANGES

Herbert L. Rawlins has been named manager of the Protective Devices Engineering Department, Westinghouse Electric and Manufacturing Company, replacing L. R. Ludwig, who was recently appointed manager of the Motor Division.

A. W. Hill, design engineer, now becomes manager of Power Circuit Breaker Engineering, also part of Mr. Ludwig's former responsibility.

Adolph Frankel has been appointed manager of the Electronic Tube Sales Department of the Westinghouse Lamp Division, with headquarters at Bloomfield, N. J.

A. Carl Bredahl, chief of the mechanical-electrical-utilities division of the Federal Public Housing Authority since 1934, has been appointed technical director of the Westinghouse Better Homes Department.

•

G-E APPOINTMENTS

W. T. Darcy has been appointed manager of service shop sales at General Electric. It is Mr. Darcy's responsibility to supervise and coordinate the repair and renewal parts business-building activities of G-E service shops all over the country. He retains his duties as manager of renewal parts division, industrial divisions, in addition to his new position.

E. E. Williams has been appointed sales manager of the Laboratory and Measuring Equipment Section of the G-E Specialty Division. Mr. William's headquarters will be at Schenectady, N. Y.

•

TRIANGLE APPOINTMENTS

W. J. Dwyer, who has acted as assistant sales manager for the past three years, has been appointed sales manager of the Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.

Fackler Sales Co., 50 Church Street, New York, N. Y. has been named Triangle representatives in the Metropolitan Area of New York.

•

Crocker-Wheeler Electric Manufacturing Company, Ampere, N. J. has named The California Electric Works, Inc., of San Diego, Calif. as distributors. They will operate under the supervision of Crocker-Wheeler's newly established Los Angeles district office.

SYLVANIA CHANGES

Sylvania Electric Products, Inc. announces the appointment of B. K. Wickstrum as Pacific Coast sales manager, for its lighting products. He will have two assistants, C. W. Dickinson, manager of the Northwest Division with headquarters in Seattle and G. W. Field, manager of the California Division, which includes Nevada, Utah and Arizona in addition to California.

Mr. Wickstrum and Mr. Field will occupy offices at 555 South Flower Street, Los Angeles and Mr. Dickinson will have offices in Seattle.

George C. Connor has been appointed manager of the California division of equipment tube sales. He will be located at 555 South Flower Street.

•

Westinghouse Electric Supply Company, New York announces that V. C. Bruce Wetmore has relinquished active management of the New England (Wetmore-Savage) District, devoting himself to the overall company interest in its customer relationships.

E. V. Wetmore, formerly assistant district manager, becomes New England district manager in charge of the Supply Company business.

•

Owens-Corning Fiberglas Corporation has transferred William R. Northlich from the Washington, D. C. office to the general offices in Toledo, Ohio, as assistant to the general sales manager. He is succeeded in Washington by A. E. Kincaid, Jr.

•

Graybar Electric Company, Inc. announces the appointment of J. E. Fontaine as manager of the Beaumont, Texas office. He replaces J. P. O'Neill who died recently after 27 years of continuous service with the company.

•

Allen Bradley Company of Milwaukee, Wis. has named Rietze & Co., 1017 E. Broadway, Louisville, Ky., as sales representatives. Rietze will handle the southern Indiana and western Kentucky territories.

•

Penn-Union Electric Corporation, Erie, Pa. has named Fackler Sales Corp., 50 Church Street, New York, N. Y. as representatives in the Metropolitan area of New York.

•

The Standard Transformer Co. of Warren, Ohio, announces the appointment of Joseph M. Burns as its Northern Ohio representative. Mr. Burns is located at 2033 Atkins Ave., Lakewood and will cover municipal, private and R.E.A. electric utility companies.

Economics of Lighting Maintenance

[FROM PAGE 35]

cent costs were estimated at 48 cents per lamp while group replacement costs were estimated at 12 cents per lamp. To the replacement costs were added net lamp costs giving a total per-lamp figure for lamp-and-handling charge. Included in the replacement costs were washing costs at the time of replacement only.

Thus, knowing the average lumens output per lamp (taking lumens depreciation into account resulting from decreasing efficiency) and the number of lamp-hours operation, a table of cost values in dollars per million lumen hours output was calculated.

Two typical columns from the cost-of-light tables based on a group of 1000 white lamps 100-watt, follows this pattern:

Operating hours ...	3000	4000
Percent lamps out ..	0	0
Kwh. (based on 117.5 watts per lamp)	352.500	470,000
Million lumen hours delivered (decreased efficiency accounted for)	10,584	13,672
Cost of lamps and handling (based on group replacement)	$1517	$1517
Energy cost @ $1.062¢ kwh. (equivalent)	$3744	$4991
Total Cost	$5261	$6508
Dollars per Million Lumen Hours....	$0.497	$0.476

One thousand lamps operating 3000 hours gives three million lamp hours. 117.5 watts per lamp gives a total of 352,500 kwh. At 3528 lumens per lamp, a total of 10,584 million lumen hours are delivered. Note that at 4000 hours the lumens per lamp have depreciated from 3528 to 3418, a reduction of 110 lumens per lamp in the 1000 additional operating hours giving a total million lumen hours of 13,672.*

From this data the curves of Fig. 3 have been drawn. Also on Fig. 3, a foot-candle curve has been drawn for a typical factory area. This foot-can-

*Edit. Note: This rate of lumen depreciation is much slower than the foot-candle depreciation found by actual measurement. If the lumens delivered followed the foot-candle depreciation pattern, the cost curves, (that is, curves A and B of Fig. 3) would look quite a bit different. Both would take the shape of a V, with the cost decreasing to a minimum at between 3000 and 4000 hours and rising sharply for increased operating hours beyond 4000.

[Continued on page 166]

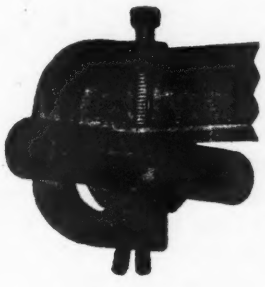
LATROBE

FLOOR BOXES — WIRING SPECIALTIES

PRODUCTS

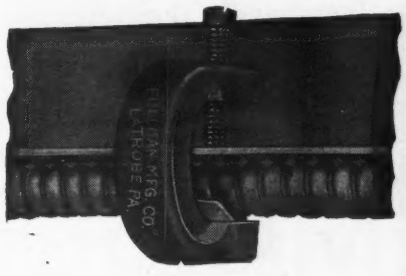
QUALITY THAT LASTS

Quicker installation of Latrobe Floor Boxes and wiring specialties saves valuable man hours in war production plants throughout the country—and once installed, they do a job to be proud of. Same is true for all industrial, commercial and residential uses.



"BULL DOG"
PIPE OR CONDUIT HANGER

Most economical and satisfactory for hanging ½, ¾ or 1" pipe or conduit to steel beams ⅜" thick. Adaptable also for a wide range of work.

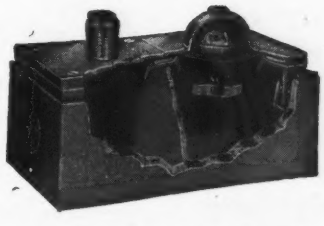


"BULL DOG"
ARMORED CABLE SUPPORT

A light, strong, sure clamp for supporting or hanging armored cable to steel framework. Easily installed. Will not deface surface nor shake loose.

No. 130
LATROBE WATERTIGHT FLOOR BOX

Shown here with No. 207 Bell Nozzle. Tapered Unit Receptacle fits tapered opening in adjusting ring.



No. 252-R FLOOR BOX With Nos. 206 and 207 NOZZLES

Brass flange frames are securely fastened to iron adjusting frames to prevent floors from chipping when cover plates are removed.

No. 403
INSULATOR SUPPORT

Malleable iron of high tensile strength for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

EASILY INSTALLED

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MANUFACTURING CO.
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PORTABLE ELECTRIC RECHARGEABLE
HAND SEARCHLIGHT

Demonstration proves its true value.

Provides
DAYLIGHT VISIBILITY
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★ BIG BEAM is in a class all by itself . . . there is nothing remotely like it. The light beam picks out objects over 2,500 feet away—interchangeable lens diffuses the same volume of light over a wider area for close-up work. Hard wear does not impair efficiency and heavy duty battery is shockproof. Battery does not have to be removed from container for recharging, method is simple, clean and safe. Large industrial plants all over the country are BIG BEAM users. Our NEW Catalog gives complete facts on all types of BIG BEAM Portable Electric Rechargeable Hand Searchlights and the Accessories . . . send for a copy today. The time is right to get started on this profitable product.

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•

G-E APPOINTMENTS

W. T. Darcy has been appointed manager of service shop sales at General Electric. It is Mr. Darcy's responsibility to supervise and coordinate the repair and renewal parts business-building activities of G-E service shops all over the country. He retains his duties as manager of renewal parts division, industrial divisions, in addition to his new position.

E. E. Williams has been appointed sales manager of the Laboratory and Measuring Equipment Section of the G-E Specialty Division. Mr. William's headquarters will be at Schenectady, N. Y.

•

TRIANGLE APPOINTMENTS

W. J. Dwyer, who has acted as assistant sales manager for the past three years, has been appointed sales manager of the Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.

Fackler Sales Co., 50 Church Street, New York, N. Y. has been named Triangle representatives in the Metropolitan Area of New York.

•

Crocker-Wheeler Electric Manufacturing Company, Ampere, N. J. has named The California Electric Works, Inc., of San Diego, Calif. as distributors. They will operate under the supervision of Crocker-Wheeler's newly established Los Angeles district office.

SYLVANIA CHANGES

Sylvania Electric Products, Inc. announces the appointment of B. K. Wickstrum as Pacific Coast sales manager, for its lighting products. He will have two assistants, C. W. Dickinson, manager of the Northwest Division with headquarters in Seattle and G. W. Field, manager of the California Division, which includes Nevada, Utah and Arizona in addition to California.

Mr. Wickstrum and Mr. Field will occupy offices at 555 South Flower Street, Los Angeles and Mr. Dickinson will have offices in Seattle.

George C. Connor has been appointed manager of the California division of equipment tube sales. He will be located at 555 South Flower Street.

•

Westinghouse Electric Supply Company, New York announces that V. C. Bruce Wetmore has relinquished active management of the New England (Wetmore-Savage) District, devoting himself to the overall company interest in its customer relationships.

E. V. Wetmore, formerly assistant district manager, becomes New England district manager in charge of the Supply Company business.

•

Owens-Corning Fiberglas Corporation has transferred William R. Northlich from the Washington, D. C. office to the general offices in Toledo, Ohio, as assistant to the general sales manager. He is succeeded in Washington by A. E. Kincaid, Jr.

•

Graybar Electric Company, Inc. announces the appointment of J. E. Fontaine as manager of the Beaumont, Texas office. He replaces J. P. O'Neill who died recently after 27 years of continuous service with the company.

•

Allen Bradley Company of Milwaukee, Wis. has named Rietze & Co., 1017 E. Broadway, Louisville, Ky., as sales representatives. Rietze will handle the southern Indiana and western Kentucky territories.

•

Penn-Union Electric Corporation, Erie, Pa. has named Fackler Sales Corp., 50 Church Street, New York, N. Y. as representatives in the Metropolitan area of New York.

•

The Standard Transformer Co. of Warren, Ohio, announces the appointment of Joseph M. Burns as its Northern Ohio representative. Mr. Burns is located at 2033 Atkins Ave., Lakewood, and will cover municipal, private and R.E.A. electric utility companies.

Economics of Lighting Maintenance

[FROM PAGE 35]

ment costs were estimated at 48 cents per lamp while group replacement costs were estimated at 12 cents per lamp. To the replacement costs were added net lamp costs giving a total per-lamp figure for lamp-and-handling charge. Included in the replacement costs were washing costs at the time of replacement only.

Thus, knowing the average lumens output per lamp (taking lumens depreciation into account resulting from decreasing efficiency) and the number of lamp-hours operation, a table of cost values in dollars per million lumen hours output was calculated.

Two typical columns from the cost-of-light tables based on a group of 1000 white lamps 100-watt, follows this pattern:

Operating hours ...	3000	4000
Percent lamps out ..	0	0
Kwh. (based on 117.5 watts per lamp)	352,500	470,000
Million lumen hours delivered (decreased efficiency accounted for)	10,584	13,672
Cost of lamps and handling (based on group replacement)	$1517	$1517
Energy cost @ $1.062¢ kwh. (equivalent)	$3744	$4991
Total Cost	$5261	$6508
Dollars per Million Lumen Hours....	$0.497	$0.476

One thousand lamps operating 3000 hours gives three million lamp hours. 117.5 watts per lamp gives a total of 352,500 kwh. At 3528 lumens per lamp, a total of 10,584 million lumen hours are delivered. Note that at 4000 hours the lumens per lamp have depreciated from 3528 to 3418, a reduction of 110 lumens per lamp in the 1000 additional operating hours giving a total million lumen hours of 13,672.*

From this data the curves of Fig. 3 have been drawn. Also on Fig. 3, a foot-candle curve has been drawn for a typical factory area. This foot-can-

*Edit. Note: This rate of lumen depreciation is much slower than the foot-candle depreciation found by actual measurement. If the lumens delivered followed the foot-candle depreciation pattern, the cost curves, (that is, curves A and B of Fig. 3) would look quite a bit different. Both would take the shape of a V, with the cost decreasing to a minimum at between 3000 and 4000 hours and rising sharply for increased operating hours beyond 4000.

[Continued on page 166]

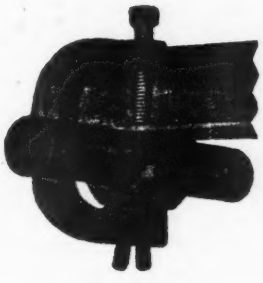
LATROBE

FLOOR BOXES — WIRING SPECIALTIES

PRODUCTS

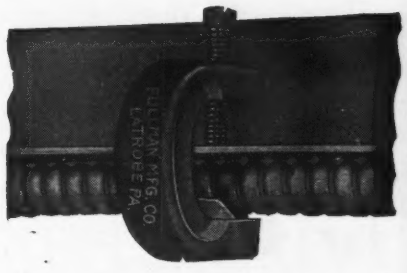
QUALITY THAT LASTS

Quicker installation of Latrobe Floor Boxes and wiring specialties saves valuable man hours in war production plants throughout the country—and once installed, they do a job to be proud of. Same is true for all industrial, commercial and residential uses.



"BULL DOG" PIPE OR CONDUIT HANGER

Most economical and satisfactory for hanging ½, ¾ or 1" pipe or conduit to steel beams ⅜" thick. Adaptable also for a wide range of work.



"BULL DOG" ARMORED CABLE SUPPORT

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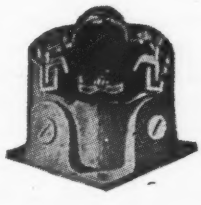
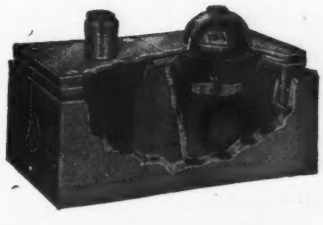


No. 130 LATROBE WATERTIGHT FLOOR BOX

Shown here with No. 207 Bell Nozzle. Tapered Unit Receptacle fits tapered opening in adjusting ring.



No. 252-R FLOOR BOX With Nos. 206 and 207 NOZZLES

Brass flange frames are securely fastened to iron adjusting frames to prevent floors from chipping when cover plates are removed.

No. 403 INSULATOR SUPPORT

Malleable iron of high tensile strength for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

EASILY INSTALLED

FULLMAN MANUFACTURING CO. LATROBE, PA.

ECONOMICAL

–by switching to KONDU Fittings:"

✔ You can use ANY kind of conduit — heavy or Thin-Wall — at ANY outlet.

✔ You can make either a Threadless or a Threaded connection—at ANY outlet.

✔ Take out the box any time, without disturbing conduit.

✔ You can install the conduit, if necessary, before the fittings are delivered.

✔ Choose from widest variety of threadless conduit fittings.

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Write for the Kondu Catalog.

KONDU CORPORATION
ERIE, PA.

Economics of Lighting Maintenance

[FROM PAGE 165]

dle curve C is the same as curve E of Fig. 2. A critical minimum foot-candle zone has been established between 30 and 35 foot-candles. Thus by reflecting this critical zone to the "thousands of hours" coordinates, it is seen that fixtures must be relamped at between 3500 and 5000 hours to avoid dropping below the established minimum.

Although the savings in group replacement over individual seem small (the difference between curve A and curve B of Fig. 3) calculations will show that the annual savings for a group replacement at 4500 hours will net an annual saving of approximately 15,000 dollars. This, added to savings realized from a single interruption to production as against several involved in individual replacement leaves no doubt as to the value of group replacement in this instance.

Results

The study has resulted in a maintenance procedure of group replacement at approximately 4000 hours. The fixtures are washed at this time only, and not between replacements. Serious study was also given to the washing operation, that is, should the fixture be washed in place or should it be removed and replaced immediately with one already washed. Several factors were involved in the decision to remove the dirty fixture and replace it with a clean one.

First, by clocking each procedure it was found that washing a fixture in place took from six to eight minutes longer than removing and replacing. Thus, interruption to production and distraction to surrounding employees was greater by that length of time for each fixture serviced. Further, it was found less costly to hire a third member for each crew to act as messenger by supplying the two crew-men with new lamps and clean fixtures, and by removing dirty fixtures to the washroom where he could wash the fixtures at his leisure. Another factor, and one probably more important than the first, is that by removing the fixture, the maintenance electricians have an opportunity to inspect for loose sockets, bad ballasts and loose wiring connections. This inspection procedure has proven to be very effective insurance against costly call backs on leaking ballasts or other trouble. However, this leaking ballast trouble caused by overload from flickering lamps has been curtailed considerably by use of a "no-blinking" starter. All starters are being (or have been) changed over to this new type at the time of the routine lamp replacement.

Several "crow's nests" have been purchased to speed replacement and to get at fixtures over machinery that are inaccessible with ordinary ladders. Use of the crow's nests also greatly reduce interruption to production since machines can continue to operate while the relamping crew-men work safely on the overhanging platform.

The crow's nest has a very heavy steel and concrete base and is carried about the plant on a battery truck. The ladder can be swung horizontally through 360 degrees. It can be adjusted vertically from straight up to almost straight out. The working platform can be adjusted to horizontal for almost any angle at which the ladder is set. Thus, the heavy base can be set in the aisle, while the platform is swung out over machinery on either side to reach fixtures. Once set, all adjustments are locked and two men can work safely as in the accompanying photo.

Three men are assigned to a crow's nest crew. Two maintenance electricians work on the ladder while the messenger works on the floor to take the old lamps and reflectors, and supply new lamps and clean reflectors. Because of the large floor area, the messenger is provided with a bicycle truck to cart fixtures and lamps back and forth.

After the reflector has been removed and while the one crew-man carries it down to the floor, the other gives all the wiring, sockets, starters and ballast a careful inspection. If new starters haven't already been installed, they are replaced with the "no-blinking" type. If ballasts look leaky, they too are replaced. The clean fixture and new lamps are installed and no maintenance is effected for another 4000 hours.

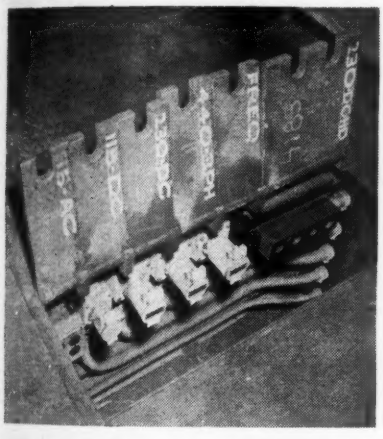
Practical Methods

[FROM PAGE 40]

each pull-box, but within the span of three consecutive service points which would be a distance of twenty-eight feet, any particular service can be obtained.

A heavy cast-iron hinged plate is installed over each receptacle. The plate is notched so that after the test jack is inserted, the plate can be closed and the notch accommodates the cable. The plates are also marked on both sides with large, clear letters as to the service provided by that receptacle directly underneath.

A total of six services are provided: 115 volts, single phase, 60 cycle a.c.; 115 volts, d.c.; 230 volts d.c.; 440 volts.



TEST SERVICES are available every fourteen feet. Five cement trenches 200 feet long, supply the assembly areas. The covering plates are marked on both sides to facilitate selection, and are notched to accommodate the cable when closed.

3 phase, 60 cycles a.c.; variable voltage and frequency; and 230 volts heavy duty 200 amps. d.c.

Two single phase auto-transformers connected in open delta are fed by a variable speed—variable voltage three phase generator. The driving motor is direct current, field controlled by rheostat to obtain the required generator speed, and consequently, output frequency. Field excitation control of the three phase synchronous generator acts as a partial voltage control. Input and output taps of the transformers (secured by double throw knife switches) controls the phase output and various wide steps in voltage. Vernier voltage control is then obtained by varying generator field excitation.

Thus, the various services available over the variable frequency—voltage circuits are any combination: 25 to 60 cycles, 110 to 550 volts and 2 or 3 phase.

Engineering Developments

[FROM PAGE 40]

a *maximum-torque winding* and a *maximum-torque-per ampere* winding.

In general, the maximum-torque-per-ampere winding results in less weight of starting-winding copper and works the starting winding harder than the maximum torque winding. Practical windings are often a compromise between the two, generally favoring the former as far as possible.

Resistance-Start Motors—A resistance-start motor differs from a split-phase motor only in that an external resistance is used in series with the starting winding. In such a case, R_a as used in the mathematical expressions must be assumed to include the resistance of the external resistor as well as the windings resistance.

Best Winding For a Capacitor-Start Motor—Selection of an auxiliary winding and capacitor for a capacitor-start motor requires the exercise of judgment and experience that cannot be wholly expressed in the form of equations. Attention must be paid to the voltage across the capacitor, not only for the locked-rotor condition, but also for all speeds up to switch-operating speed. Usually it will be necessary to make a number of trial designs before selecting the best one to meet the conditions specified.

Reactor-Start Motors—Reactor-start motors are generally similar to split-phase motors except that, during the starting period, an external reactor is connected in series with the main winding.

A New Three-Element Current Limiting Power Fuse

In order to meet the requirements for the protection of high voltage motor starters and for protecting small loads and apparatus connected to those parts of electrical systems having extremely high short-circuit currents, it has been necessary to increase the current range of the three-element current limiting fuse.

The development of higher current ratings in a fuse of suitable dimensions produced problems and solutions totally different from those previously encountered. A new type of fusible element has a time-current characteristic particularly suited to current limiting fuses. Extremely fast melting times on high currents to give correct cur-

[Continued on page 168]

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motor-capacitor
REPLACEMENTS

● The Aerovox Victory Line is the answer to wartime conditions and restrictions. A drastic reduction in number of types has been achieved without impairing satisfactory servicing. You can keep those electric refrigerators running for the duration, with these replacements . . .

AEROVOX VICTORY REPLACEMENTS

Victory Line of 22 types of electrolytic capacitors for 110-volt operation; 6 types for 220-volt.

These 30 universal types can take care of upwards of 90% of all motor-starting capacitor replacements.

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Engineering Developments

[FROM PAGE 167]

rent limiting action are combined with a continuous current carrying capacity and normal melting time of an element having five times the area previously associated with the current limiting characteristic. The association of this element with gas-evolving material and quartz sand to give quick and positive current limitation while the metal vapors are absorbed, results in an entirely new fuse construction. The combination of this current limiting element with a non-inductive resistor of special characteristics and a totally enclosed boric acid "clean-up" fuse has resulted in a current limiting fuse of more compact construction than has heretofore been available in the ratings involved. Exhaustive tests have demonstrated the suitability of the new fuse for application on high capacity systems to interrupt the full range of fault currents with minimum system disturbance.

A New Electric Hoist Drive For Cranes

The ideal characteristics for the hoist applications under consideration have been approximated closely by the development of a radical improvement of the Ward-Leonard system, the principal feature of which is the addition of an exciter of unusual design embodying a cross-flux principle. By this means, a characteristic is obtained in which the voltage of this cross-flux exciter is responsive in a unique manner to the variations of magnitude and polarity of the current in the "loop" circuit, that is, the local circuit comprised by the armatures of the generator and hoist motor. At zero "loop" current the voltage of this exciter is at its maximum. At substantial increases of "loop" current, irrespective of polarity, the voltage of this exciter decreases, and at the maximum overload values of the "loop" current the voltage closely approaches zero. The voltage generated by this exciter provides the excitation of the generator field and modifies the excitation of the hoist motor field.

The generator, cross-flux exciter, and an ordinary constant-voltage exciter are driven by an induction motor, or if preferred for a sufficient reason by a synchronous motor or a d.c. motor. An engine drive tends to be an improper choice, since the engine is unable to reconvert the energy regenerated by a descending load and hence is unable to restrain the speed of a descending load.

The hoist motor has a nonstandard main-field winding for a variable separate excitation but in other respects is of the type which is standard for high-class crane-hoist installations.

If it were intended to use the cross-flux exciter solely to furnish a generator excitation of the desired characteristics, it would be appropriate to consider an arrangement which connected the generator field directly to the armature of the cross-flux exciter, whereupon the hoist could be reversed and controlled by reversing and controlling the strength of the separately excited main field of this exciter. However, another important function of the cross-flux exciter is to provide an advantageous variation of the hoist-motor excitation. In order that one cross-flux exciter shall serve both of these purposes (by virtue of the unusual circuit arrangement used), it is necessary that the main-field excitation of this exciter be maintained nonreversible and at a substantial value which is not far from constant. Accordingly, a conventional reversing control is provided between the exciter armature and the generator field, as in the elementary diagram of Fig. 4.

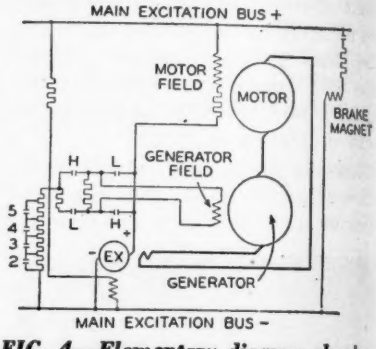

FIG. 4—Elementary diagram showing cross-flux exciter connections.

This scheme of motor-field excitation provides three benefits:

1. Most important: an ample margin of torque stability is provided at all loads, both steady-state and transient.

2. A maximum speed of the empty hook is obtained which is moderately greater than that corresponding to the maximum no-load voltage of the generator.

3. Without any complication of contactors, relays, or the like in the motor-field circuit, the motor field continues strong at the "off" position of the controller during a retardation but is reduced to a value moderately less than normal while the hoist continues to stand at rest at the "off" position.

Modern Lighting

[FROM PAGE 78]

hot drawn. The surface of the cold rolled stock is inclined to be specular so that the light source should be located directly over the brake. The light source would be reflected from the surface of the stock leaving the scribe mark dark in contrast.

With hot-drawn stock the lighting problem is different. Since the surface of the material is dark, the lighting unit should be located in front of the brake so the light will be reflected *away* from the operator leaving the surface dark and the scribed mark lighted. Where both types of stock are used on the same machine, it would be best to use two sets of lighting units, or some similar arrangement, so proper lighting could be used as needed. Since it is reflected light that permits best seeing of the mark, it is important that the fixture be of the large area, low brightness type.

Power Brake—Since the power brake or folding machine is generally quite large—often 20 feet or more in length—the lighting should be directed from both front and rear of the machine. Units cannot be placed too close to the machine, since 6 and 8-ft. stock, when folded, will describe an arc and possibly strike the fixtures.

Rear stops generally are set from the front of the machine by measuring from the center line of the female or bottom die with an adjustable-head steel square—the stops being run up to the end of the square and adjusted by feel. Light is necessary behind the press to raise and lower the stops and to permit the operator to work behind the brake with comfort and safety. Frequently scribed lines and punch marks are used instead of back stops, in which case the mark is adjusted to the slowly descending upper die. If the light source is located too close to the machine, the descending die will cast a shadow making it impossible to see the scribed line.

A man may be required at each end of the machine when working with large sheets, necessitating a light at each end. If the machine is quite large a general overhead lighting system may be employed. This will suffice providing the machine is surrounded by at least four fixtures—500 watts each (incandescent) or 200 watts each (fluorescent)—spaced not greater than 10-ft. by 10-ft. A 35 foot-candle level of general illumination is desirable to facilitate changing of the dies, making necessary adjustments and preventing damage to the sharp bending edges. The recommended type of fixture is the RLM fluorescent unit.

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FOR SHOVELS • CRANES • TRACTORS • OR MOUNTING ON POSTS • OUTBUILDINGS • ETC.

ST-200 FOR 200-WATT INCANDESCENT

Peak Lighting AT LOW COST with NEW 200 watt FLOODLIGHT

SPECIFICATIONS

Height overall, 12½". Length, front to back, 11¼" Lens, 8⅜" in diameter. Metal finish, dull olive drab. Net weight, 6½ lbs.

UNIVERSAL ADJUSTMENT

Floolight is easily, quickly positioned to direct the light where wanted – 250° swing vertically, 360° horizontally – simply by adjusting wing bolts on bracket and base.

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Rugged in construction, incorporating features found only in larger, higher-priced floodlights, highly resistant to shock and vibration, weather-proof and corrosion-resistant, equipped with the famous silver-mirrored-glass Permaflector, steel protective housing, heat-resisting lens, (easily removable for maintenance.)

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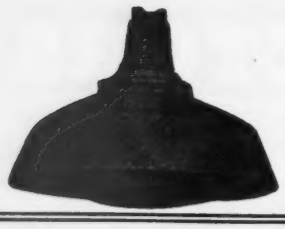

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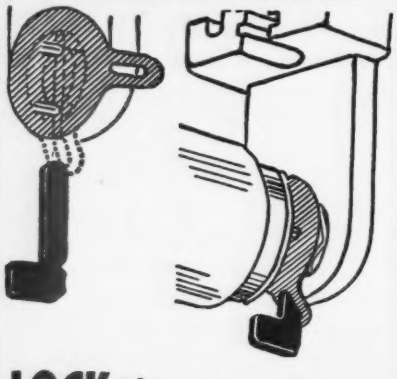

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VIBRATION DIFFICULTIES

It is a conceded fact that vibration at fluorescent lamp contacts considerably impairs the efficiency of lamps, starters and ballasts. Flur-o-locks aid materially in preventing this condition. Furthermore Flur-o-locks insure the proper installation of lamps and offer definite protection against accident hazards wherein lamps are apt to fall from a fixture. Such accidents have occurred causing quite some material damage and personal injury. FOR SAFETY AND CONSERVATION USE FLUR-O-LOCKS.

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Fundamentals of Electronic Tubes [FROM PAGE 41]

most instantaneous. A vacuum phototube is so sensitive and fast in response that a small change in light intensity can be instantly detected. As the electron emission current is usually very small, an amplifier is used to amplify the output to a magnitude that is of some practical use.

The phototube follows definite laws stated by Einstein in 1905. The number of electrons emitted from a cathode surface are directly proportional to the intensity of the light, and the velocity of the emitted electrons depends upon the surface of the cathode and wave length of the illumination.

Typical phototubes are manufactured with either a vacuum or a gaseous medium between the electrodes. Fig. 33 illustrates the characteristic difference between a vacuum and a gas filled phototube. The characteristics of the vacuum phototube are the most stable and the output is directly proportional to the illumination. Typical vacuum phototubes may be operated with a maximum of 500 volts between the cathode and anode. A gaseous phototube will provide a greater output per unit of light than a vacuum phototube as the creation of electrons and positive ions by the collisions between electrons and gas molecules act to increase the effective tube current. The gas in this type of tube performs the same function as the gas in a hot cathode gaseous tube which was previously discussed. An inert gas such as argon is usually used in gaseous phototubes as it does not react chemically with the light sensitive surface.

Gaseous tubes are not usually operated with more than 90 volts between the cathode and the anode as a voltage which exceeds 90 volts may cause a glow discharge in the tube. Such a glow discharge will probably destroy the sensitive cathode surface and the tube will lose control of the anode current for when a discharge once starts the current will be independent of the illumination.

Phototubes are manufactured with the maximum response in a certain spectral region. Typical tubes are available for response near ultra-violet, deep red and near ultra-violet, violet, and for wave length regions of 1700 to 2700, 2500 to 3200, and 2500 to 3650 angstroms wavelength of light. Fig. 34 shows the response characteristics of several phototubes with relationship to the visible spectrum. An angstrom unit is a wave length of .0000001 millimeter. (1×10^{-7} mm.)

Phototubes are inherently suited for the control of lightning, starting and stopping of mechanical operations, and for counting operations. The tube may also be used to record the density of smoke, or solutions, or to detect the presence of smoke or fire. This tube is sensitive enough to discriminate the difference in size, thickness, and color of objects. Phototubes are recommended for any application where friction should not be introduced or a mechanical connection cannot be made to the device. With phototube control, elevators can be accurately stopped at floor positions, paper can be accurately cut with respect to certain designs printed on it, doors can be opened or closed, and many safety functions can be performed. The application of a phototube to a motion picture machine to translate the film sound track into audible and intelligible sound is a very common and practical application.

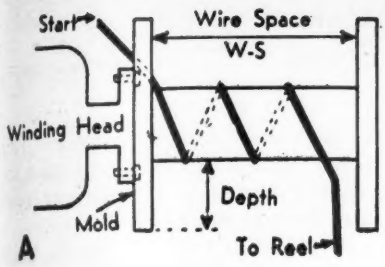
Motor Shops [FROM PAGE 40]

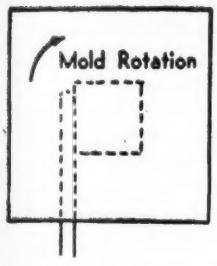
coils would be of the same polarity if the in-going lead was made the start lead of Fig. 2C, or the finish lead of 1C or lead D of the standard south pole.

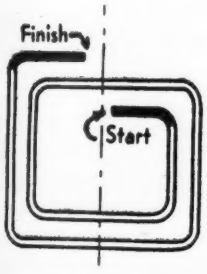
In Figs. 1 and 2 the distance between the two ends of the mold is called the wire space or (ws) of the mold and limits the number of turns of wire that can be wound into one layer. Or, the wire space of a field coil is that space between the frame and pole tip occupied by the turns of one layer of the coil. Thus, when the term TURN direction is used, it refers to building up the turns from frame to air gap, or air gap to frame, etc.

Also, the distance from the center block of the mold to the outer edge of the end plates is called the depth of the mold. This depth dimension limits the number of layers that can be wound onto a coil, or each layer, added to a field coil increases both the width and length of the coil; thus the space available between adjacent poles or coils, and at each end of the pole, determines the number of layers that can be wound on a coil. In many cases, the space between adjacent coils taper from a wide space at the pole base, to a narrow space near the air gap or pole tip and this necessitates resorting to tapered coils.

Instead of filling the wire space and depth of the molds in Figs. 1 and 2 solid with turns of wire, it may be necessary to drop turns from various layers, in







Clockwise coil i.e. coil on bench with starting lead up

FIG. 2. Method of starting the start-on-left coils, when wound straight-up. Start at left hand side of mold and wind first layer from left to right.

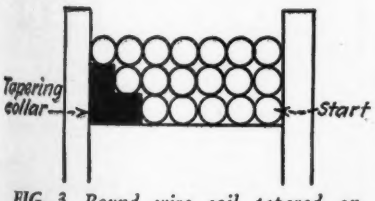


FIG. 3. Round wire coil tapered on frame side against pole, i.e. two turns dropped in first layer and one in second layer.

steps of one or more turns per layer, on one or both sides; thus the terms taper-on-right, taper-on-left, or taper right and left, indicate the side of the wire space or mold from which turns are to be dropped. When the term taper right and left is used, it means an equal number of turns are dropped on each side of the wire space. When expressed as taper 4R and 2L it means that four turns are dropped from the right hand side, and two from the left, in the one or more layers so marked.

When turns are dropped on the inside of the coil i.e., the second layer has more turns than the first and the third more turns than second or first, etc., a tapering collar is required to

[Continued on page 172]

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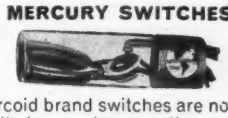

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Motor Shops

[FROM PAGE 171]

support the overhanging turns. This collar can be tapered when used for round wire, but must be stepped when used with square wire.

A coil with the taper on the inside is shown in Fig. 3. This coil is a start-on-right, taper on inside on the left. A stepped collar was used and the outward crossover from the end of the first layer to the start of the second layer is at the left in Fig. 3, thus each succeeding layer for the first two layers, has more turns than the preceding layer.

Coils with a taper on the inside are used when the junction of the pole piece and the frame, has a fillet of material instead of being machined off flat to sharp corners. A coil with the

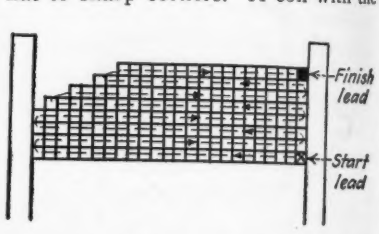


FIG. 4. Start-on-right taper on left wound straight-up.

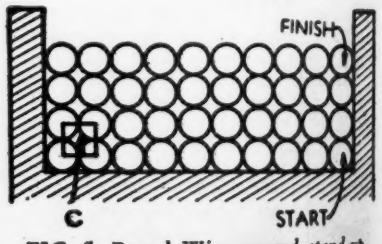


FIG. 5. Round Wire, wound stand-up, 10 turns in each layer, 40 turns total.

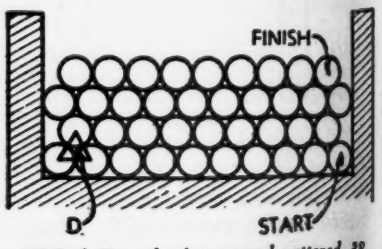


FIG. 6. Round wire, wound guttered, 38 turns (10T-9T-10T-9T). Note difference in depth of winding in A and B.

outside turns tapered or stepped off is shown in Fig. 4. This is a start-on-right and taper-left coil. Note that there are four full layers, the fifth layer has one less turn, the sixth two less than the fifth, the seventh also has two turns less than the sixth, and the eighth has two less than the seventh, and the turns are all dropped from the left-hand side of the mold.

The full section of the coil in Fig. 4 is placed next to the frame, and the taper end is toward the armature. This

makes the coil counter clockwise, i.e., the starting lead is on the frame side of the coil.

Guttered and Stand-up Windings

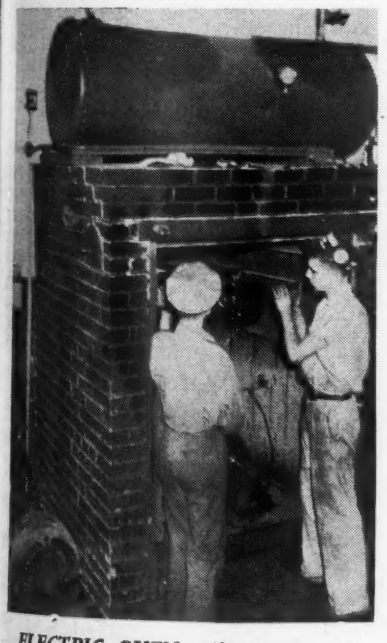
The round-wire field coil shown in Figs. 3 and 5 is wound stand-up, which when applied to round wire, means, that the turns of each layer are directly above each other, i.e., not guttered. In Figs. 3 and 5 the full width of the wire in each layer is visible and each layer can have the same number of turns.

A round-wire coil wound guttered is shown in Fig. 6. Note how the wire in the odd numbered, or every other layer, is partly hidden by the layer below and above it. With guttered coils, the turns in each succeeding layer are wound into the trough formed by space between two adjacent wires. Thus, there is one less turn in every other layer.

The guttered layer of a round-wire coil is narrower and shorter than a coil having the same size wire and same number of turns and layers.

Thus, using a guttered type wound coil has the advantage of supplying more ampere-turns in a smaller space. This is particularly important where space limitations exist, or where coil copper or insulation thicknesses have been increased.

A comparison between stand up and guttered round-wire coils is shown in Figs. 5 and 6, which shows the wire space of a mold filled by both winding methods.



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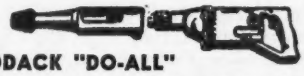

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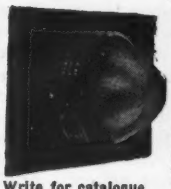

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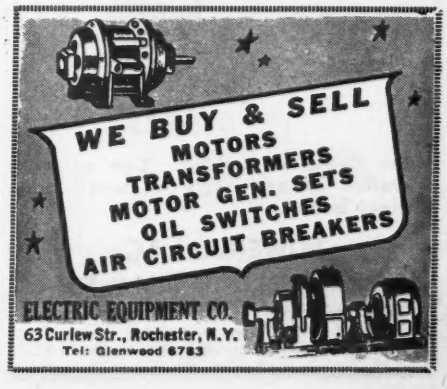

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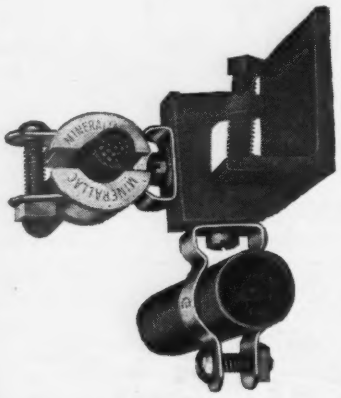

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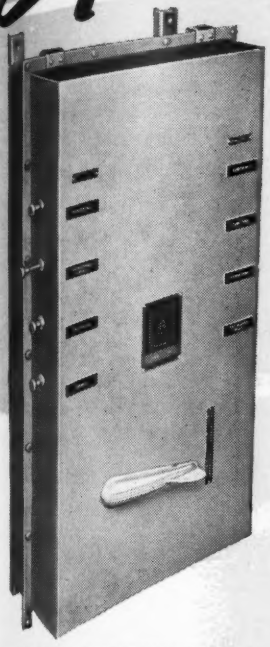

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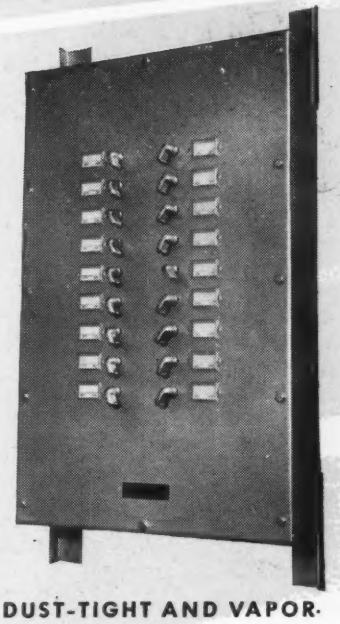

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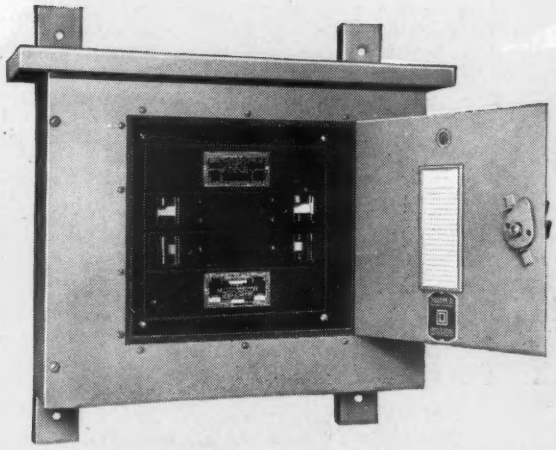
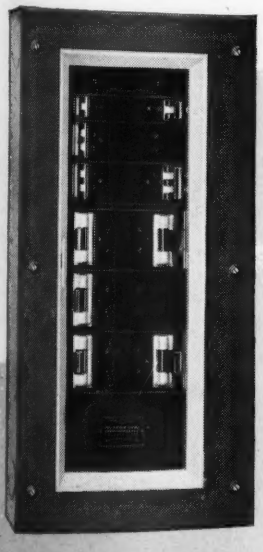
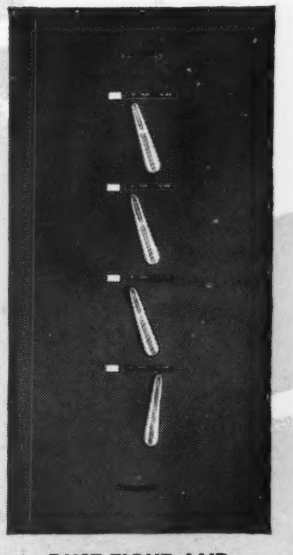


WEATHERPROOF ENCLOSURE for all types of panels, both fusible and circuit breaker. Top is extended and flat instead of sloped, thus facilitating conduit entrance.



DUST-RESISTING ENCLOSURE for fusible or circuit breaker panels. Handles are recessed as safeguard against breakage.



DUST-TIGHT AND VAPOR-PROOF ENCLOSURE with lever-type handles for easy operation of high capacity breakers.

ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

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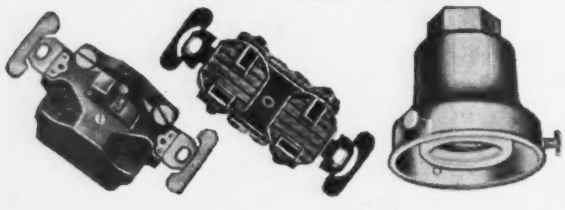
MONCOR SURFACE WIRING DEVICES

For Factories, Farm Buildings, War Housing, Military Structures, etc.

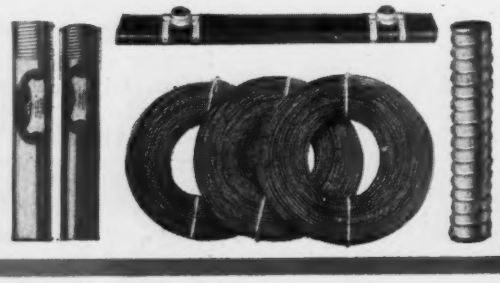
INDUSTRIAL WIRING DEVICES



There are G-E wiring devices for every sort of war-project wiring need—for maintenance, rewiring or new wiring. These devices include switches, outlets, twist-lock devices, sockets, connectors, connector bodies, caps, fuses, fluorescent lampholders and starters, etc. All of them are high quality.

G-E CONDUITS AND BUILDING WIRES

There are G-E conduits and building wires for every purpose: White and Black rigid conduits, EMT, flexible conduit, Fiberduct and various building wires including moisture-resistant wire and Type SN small diameter thermo-plastic insulated wire.



HERE are surface wiring devices you'll be proud to install. They are made of good looking, sturdy brown Textolite and provide a neat finished appearance to surface wiring systems.

Moncor Surface Wiring Devices are ideal for installation in military structures of all kinds, factories, farm buildings, war housing, garages, etc. The requirements of every surface wiring job, whether cables are exposed or hidden, are met by these devices. They are approved by the Underwriters' and they meet requirements of the specifications of different government agencies.

These devices can be installed quickly too, using either BraidX or BX. Knockouts in ends, sides and backs of the devices enable them to be end connected, side connected (knob and tube or cleat wiring) or back connected for concealed wiring.

FOR FURTHER INFORMATION about Moncor Surface Wiring Devices, G-E industrial wiring devices, wires and cables and conduits, see the nearest G-E Merchandise Distributor or write to Section CDW 341-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC